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FINAL SAMPLING AND ANALYSIS PLAN REMEDIAL INVESTIGATION SKEET AND TRAP
RANGE UNEXPLODED ORDNANCE 08 (UXO 08) DAM NECK ANNEX NAS OCEANA VA
07/01/2014
CH2M HILL

SAP Worksheet #1—Title and Approval Page

Final

Sampling and Analysis Plan Remedial Investigation Skeet and Trap Range (UXO 08) Dam Neck Annex

**Naval Air Station Oceana
Virginia Beach, Virginia**

Contract Task Order WE59

July 2014

Prepared for

**Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic**

Under the

**NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012**

Prepared by:



Virginia Beach, Virginia

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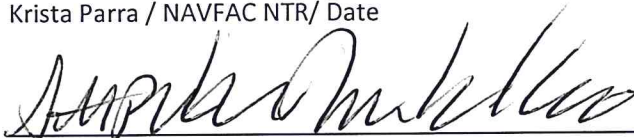
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Executive Summary

This site-specific Sampling and Analysis Plan (SAP) is being submitted to provide a systematic data collection and analysis structure for the Skeet and Trap Range Remedial Investigation (RI), UXO 08, at Dam Neck Annex (DNA) of Naval Air Station (NAS) Oceana, Virginia Beach, Virginia. In accordance with the Guidance for Uniform Federal Policy (UFP) for Quality Assurance Project Plans (QAPP) (USEPA, 2005), this United States Navy (Navy)-specific SAP includes 37 worksheets that detail various aspects of the environmental investigation process and serves as guidelines for the field work and data quality.

The Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic is conducting this RI under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). CERCLA work is being conducted with the Virginia Department of Environmental Quality (VDEQ) as the lead regulatory agency. This document will help ensure that environmental data collected or compiled are scientifically sound, of known and documented quality, and suitable for intended uses. The laboratory information cited in this SAP is for the analytical laboratories that are currently contracted to provide analytical services for this investigation. The analytical services will be provided by Katahdin Laboratory and EnviroSystems as the primary laboratories. Test America has been subcontracted by Katahdin for the analysis of grain size and sulfide. Data validation (DV) services will be provided by CH2M HILL.

The purpose of this RI is to determine if site-related contamination associated with historical Skeet and Trap Range activities warrants additional CERCLA action at DNA. The former Skeet and Trap Range is located in the southwestern portion of DNA, on the eastern shore of Lake Tecumseh. The site is north of Bullpup Street and west of Regulus Avenue. The Skeet and Trap Range was composed of four skeet and four trap firing positions. Potential sources of contamination present at the range are debris related to small arms ammunition and clay targets. Approximately half of the range fan extended into Lake Tecumseh. Based on historical aerial photographs, the firing line was located north of Bullpup Street with the direction of fire toward the northwest over Lake Tecumseh (Malcolm Pirnie, 2008). The southeastern portion of the site, along Bullpup Street, has been developed into Building 470 and an associated parking lot. The remaining portions of the site are composed of undeveloped forest and Lake Tecumseh.

Previous site investigations have identified lead shot and clay target fragments in site soil and sediment. Surface soil and sediment samples have been analyzed for lead and polycyclic aromatic hydrocarbons (PAHs). Both lead and PAHs were identified as constituents of potential concern (COPCs) in surface soil for human and ecological receptors. Lead was also identified as a COPC in surface sediment for ecological receptors (CH2M HILL, 2012).

The nature and extent of lead and PAH impacts at the site have not yet been fully determined. The RI has been planned as a step-wise approach to delineate the nature and extent of lead and PAHs in site soil and sediment during Phase 1 of the investigation. If the results of the Phase 1 investigation indicate that groundwater has the potential to be impacted by site contaminants leaching from soil and/or that site-related contamination in soil and/or sediment poses an unacceptable risks to human and/or ecological receptors, then Phase 2 of the investigation will focus on additional sampling and testing of those media that are likely to have been impacted by site contamination to the extent that they may pose unacceptable human health or ecological risks.

Analytical data will be compared to medium-specific human health and ecological risk-based screening values. COPCs will be identified where analytes are detected at concentrations that exceed their respective risk-based screening values. If collected, groundwater data will also be compared to maximum contaminant levels (MCLs). Quantitative human health and ERAs will be performed for all COPCs identified in the respective screenings. Concentrations of contaminants determined to pose potential unacceptable risks based on the quantitative risk assessments will be compared to site-specific background concentrations to determine if they are consistent with background conditions. Following this step, medium-specific constituents of concern (COCs) will be identified. Direct ingestion of lead shot will be evaluated using the model described in *Assessment of Methods for Estimating Risks to Birds from Ingestion of Contaminated Grit Particles* (USEPA, 2011). The characterization of the number of

grit particles that are lead shot will use the methods described in *Ecological and Human Health Risks at an Outdoor Firing Range* (Pedicord and LaKind, 2000). Further action will be considered based on identified COCs, MCL exceedances, ecological modeling, and toxicity testing results.

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Acronyms and Abbreviations

°C	degree Celsius
µg/kg	microgram per kilogram
µg/L	microgram per liter
µm	micrometer
µmol/g	micromole per gram
%D	percent drift; percent difference
%R	percent recovery
AES	Atomic Emission Spectroscopy
AM	Activity Manager
AQM	Activity Quality Manager
ASE	Accelerated Soxhlet Extractor
ASTM	American Society for Testing and Materials
AVS	acid volatile sulfide
bgs	below ground surface
bss	below sediment surface
BTV	background threshold value
CA	Corrective Action
CAS	Chemical Abstract Services
CCC	calibration check compound
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-term Environmental Action—Navy
COC	constituent of concern
COPC	constituent of potential concern
CSM	conceptual site model
DFTPP	decafluorotriphenylphosphine
DQI	data quality indicator
DL	detection limit
DNA	Dam Neck Annex
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct-push technology
DQO	data quality objective
DV	data validation
Eco-SSL	Ecological Soil Screening Value
EDD	electronic data deliverable
ERA	Ecological Risk Assessment
ERP	Environmental Restoration Program
ESV	Ecological Screening Value
FCTCLANT	Fleet Combat Training Center Atlantic
FS	Feasibility Study
FTL	Field Team Leader
g	gram
GC/MS	gas chromatograph/mass spectrometer

GFAA	graphite furnace atomic absorption
GPS	global positioning system
HHRA	Human Health Risk Assessment
HRSD	Hampton Roads Sanitation District
H&S	Health and Safety
HSO	Health and Safety Officer
HSP	Health and Safety Plan
ICAL	initial calibration
ICP	Inductively Coupled Plasma
ICV	initial calibration verification
ID	identification
IS	Internal Standard
L	liter
LCL	lower control limit
LCS	laboratory control sample
LIMS	Laboratory Information Management Systems
LOD	limit of detection
LOQ	limit of quantitation
MCL	maximum contaminant level
MDL	method detection limit
MEC	munitions and explosives of concern
mg/kg	milligram per kilogram
mg/L	milligram per liter
ml	milliliter
mm	millimeter
MPC	Measurement Performance Criteria
MRM	Munitions Response Manager
MRP	Munitions Response Program
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NC	no criterion
NTR	Navy Technical Representative
ORP	oxidation-reduction potential
oz	ounce
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit
PC	Project Chemist
PID	photoionization detector
PIL	project indicator level
PFD	personal flotation device
PM	Project Manager
POC	point of contact
PPE	personal protective equipment

PQL	project quantitation limit
PQO	project quality objective
ppm	part per million
PVC	polyvinyl chloride
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plans
QC	quality control
QL	quantitation limit
QSM	Quality Systems Manual
RF	reporting factor
RI	Remedial Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RSL	regional screening level
SAP	Sampling and Analysis Plan
SDG	sample delivery group
SIM	Selected Ion Monitoring
SEM	simultaneously extracted metals
SI	Site Inspection
SOP	standard operating procedure
SPCC	system performance check compound
STC	Senior Technical Consultant
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBD	To Be Determined
TM	Task Manager
TOC	total organic carbon
UCL	upper control limit
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UTL	upper tolerance limit
UXO	Unexploded Ordnance
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

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SAP Worksheet #2—Sampling and Analysis Plan Identifying Information

[\(UFP-QAPP Manual Section 2.2.4\)](#)

Site Name/Number: Skeet and Trap Range (Unexploded Ordnance [UXO] 08),
Dam Neck Annex (DNA), Naval Air Station (NAS) Oceana

Operable Unit: Not Applicable (N/A)

Contractor Name: CH2M HILL

Contract Number: N62470-11-D-8012

Contract Title: Comprehensive Long-term Environmental Action—Navy (CLEAN) 8012

**Work Assignment
Number (optional):**

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the:
 - *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (USEPA, 2005)
 - *United States Environmental Protection Agency (USEPA) Guidance for Quality Assurance Project Plans, EPA QA/G-5* (USEPA, 2002)
2. Identify regulatory program:
 - Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
3. This SAP is a project-specific SAP.
4. List organizational partners (stakeholders) and identify the connection with lead organization:

Lead Organization: Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic

Land Owner(s): Department of Defense (DoD) and Hampton Roads Sanitation District (HRSD)

Lead Regulatory Agency: Virginia Department of Environmental Quality (VDEQ)
5. If any required SAP elements and required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion as follows:

All SAP elements required for this project are described herein. Therefore, the crosswalk table is not necessary for this project.

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SAP Worksheet #3—Distribution List

[\(UFP-QAPP Manual Section 2.3.1\)](#)

SAP Recipients	Title	Organization	Telephone Number	E-mail Address or Mailing Address
Krista Parra	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	757-341-0395	krista.parra@navy.mil
Steve Mihalko	Remedial Project Manager (RPM)	VDEQ	804-698-4202	Stephen.Mihalko@deq.virginia.gov
Bonnie Capito	Librarian	NAVFAC Atlantic	757-322-4785	Bonnie.Capito@navy.mil
Steve Falatko	Munitions Response Manager (MRM)	CH2M HILL	703-376-5099	stephen.falatko@ch2m.com
Joe Kenderdine	Project Manager (PM)	CH2M HILL	703-376-5156	joseph.kenderdine@ch2m.com
Laura Cook	Activity Manager (AM)	CH2M HILL	757-671-6214	laura.cook@ch2m.com
Renee Hunt	Task Manager (TM)	CH2M HILL	414-847-0349	renee.hunt@ch2m.com
Bill Kappleman	Ecological Risk Assessor	CH2M HILL	703-376-5152	william.kappleman@ch2m.com
Roni Warren	Human Health Risk Assessor	CH2M HILL	814-364-2454	roni.warren@ch2m.com
Mike Skeeane	Senior Technical Consultant (STC)	CH2M HILL	704- 543-3285	mike.skeeane@ch2m.com
John Tomik	Activity Quality Manager (AQM)	CH2M HILL	757-671-6259	john.tomik@ch2m.com
Anita Dodson	Program Chemist	CH2M HILL	757-671-6218	anita.dodson@ch2m.com
Seng Camus	Project Chemist (PC)	CH2M HILL	808- 440-0231	seng.camus@ch2m.com
Herb Kelly	Data Validator	CH2M HILL	352-384-7100	herb.kelly@ch2m.com
To be determined (TBD)	Field Team Leader (FTL)	CH2M HILL	TBD	TBD
Jennifer Obrin	Laboratory PM	Katahdin Laboratory	207-874-2400 x17	Jobrin@katahdinlab.com
Kathryn Kelly	Laboratory PM	Test America	802-923-1021	Kathryn.Kelly@testamericainc.com
Renee McIsaac	Laboratory PM	EnviroSystem, Inc.	603-926-3345 x209	rmcisaac@envirosystems.com

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

[\(UFP-QAPP Manual Section 2.3.2\)](#)

The responsibility of implementing the SAP will vary depending upon the role of the people and their organization. It is anticipated that the lead PM from each organization will be responsible for the overall SAP implementation. However, technical support staff, support contractors, and additional stakeholders may have input to the SAP and are also listed as potential signers, if applicable. Personnel will indicate which sections of the SAP they reviewed.

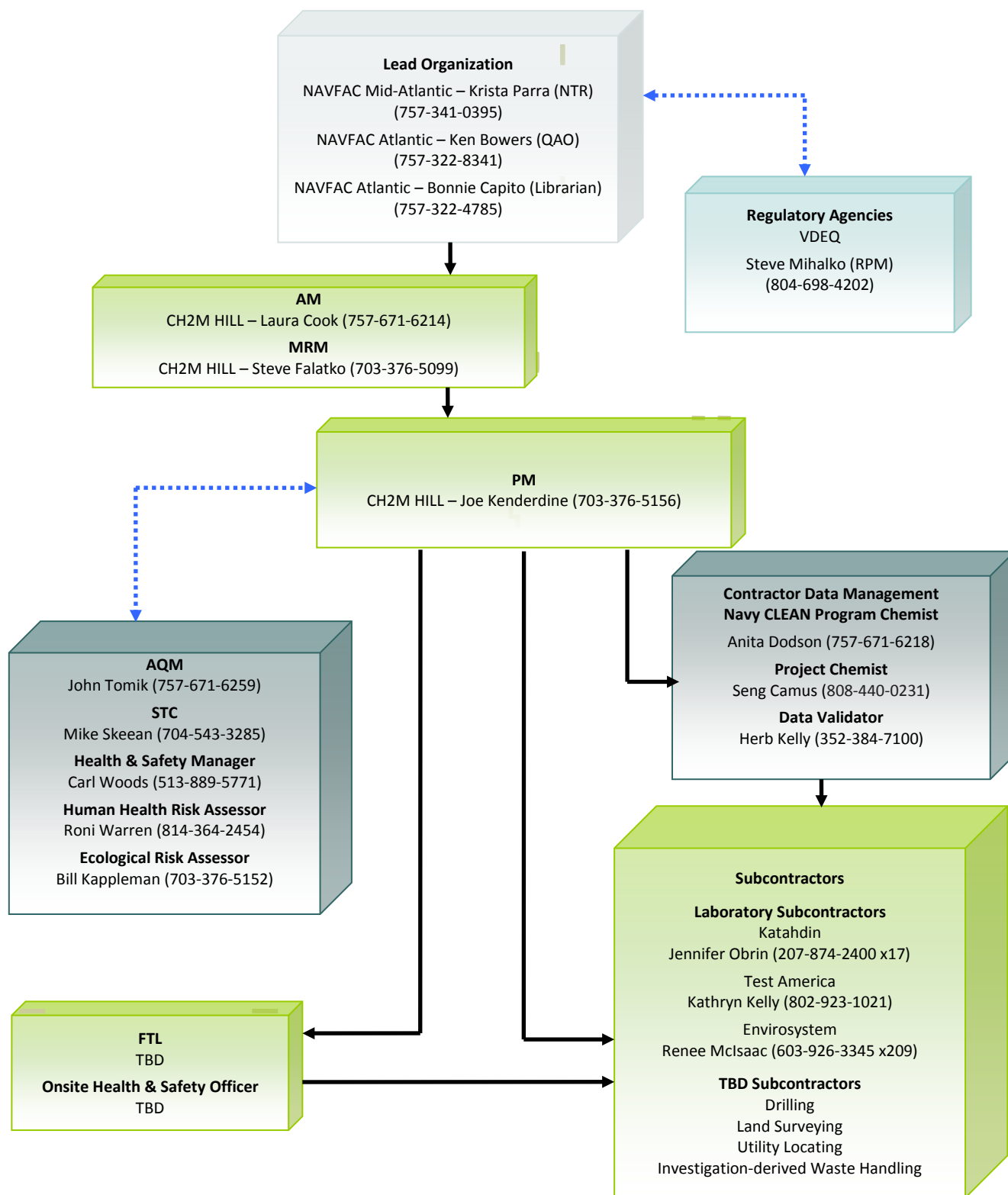
Once the Uniform Federal Policy (UFP)-SAP is finalized, CH2M HILL will send copies of it to all parties on the distribution list in **Worksheet #3** and request signatures. If signatures are returned, copies will be kept on internal CH2M HILL project folders, which are organized by activity and CTO number.

The personnel listed below acknowledge their receipt, acceptance, and approval for the listed sections of this UFP-SAP for the Remedial Investigation (RI)/Feasibility Study (FS) for the Skeet and Trap Range at DNA. The signed version of this document becomes a part of the administrative record for NAS Oceana, and a copy will be maintained in CH2M HILL's project file.

Name	Organization/Title/Role	Telephone Number	Signature/ e-mail receipt	SAP Worksheets Reviewed	Date SAP Read
Steve Falatko	CH2M HILL/MRM	(703) 376-5099			
Joe Kenderdine	CH2M HILL/PM	(703) 376-5156			
Renee Hunt	CH2M HILL/TM	(414) 847-0349			
Bill Kappleman	CH2M HILL/ Ecological Risk Assessor	(703) 376-5152			
Roni Warren	CH2M HILL/Human Health Risk Assessor	(814) 364-2454			
John Tomik	CH2M HILL/AQM	(757) 671-6259			
Mike Skeean	CH2M HILL/STC	(704) 543-3285			
Anita Dodson	CH2M HILL/Program Chemist	(757) 671-6218			
Seng Camus	CH2M HILL/ PC	(808) 440-0231			
TBD	CH2M HILL/FTL	TBD			
Jennifer Obrin	Katahdin Laboratory PM	(207) 874-2400 x17			
Kathryn Kelly	Test America Laboratory PM	(802) 923-1021			
Renee McIssac	EnviroSystem Laboratory PM	(603) 926-3345 x209			

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SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

[\(UFP-QAPP Manual Section 2.4.2\)](#)

The communication pathways for the SAP are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Communication with Navy (lead agency)	NTR, NAVFAC Mid-Atlantic	Krista Parra	757-341-0395	Primary point of contact (POC) for Navy, stakeholder and agency managers; can delegate communication to other internal or external POCs. Any issue that may affect project work should be reported to NAVFAC NTR immediately. Forwards all materials and information pertaining to the project to VDEQ RPM.
Communication regarding overall project status and implementation and primary POC with NTR	CH2M HILL MRM	Steve Falatko	703-376-5099	MRP POC for CH2M HILL; can delegate communication to other contract staff as appropriate. Issues reported to the NAVFAC NTR immediately and followed up in writing within 2 business days.
Field Progress Reports	CH2M HILL FTL	TBD	TBD	Field Progress reports will be communicated by the FTL in verbal and/or written documentation to the CH2M HILL PM daily.
Stop Work due to Safety Issues	CH2M HILL FTL	TBD	TBD	Communicate directly with the field team at the time the safety issue is identified. Provide verbal and/or written documentation of the stop work to the CH2M HILL MRM and PM immediately after work is stopped and personnel are removed from any potential hazards.
SAP Changes prior to Field/ Laboratory work	CH2M HILL PM	Joe Kenderdine	703-376-5156	Communicate directly (verbal and/or in writing) with the MRM and NAVFAC as necessary.
SAP Changes in the Field	CH2M HILL FTL	TBD	TBD	Communicate directly (verbal and/or in writing) with CH2M HILL MRM or PM with daily meetings. Documentation of deviations from the UFP-SAP made in field logbooks; deviations made only with approval of PM, who will communicate with the MRM, Department of the Navy (Navy), and regulators. The FTL will ensure SAP requirements are met by field staff.
Field and Analytical Corrective Actions (CAs)	CH2M HILL Program Chemist, PC, and FTL	Anita Dodson Seng Camus TBD	757-671-6218 808-440-0231 TBD	The need for CA for field and analytical issues will be determined by the FTL, PC, senior support staff, and/or Contractor Quality Assurance Officer (QAO) as necessary. The senior support will ensure Quality Assurance Project Plans (QAPP) requirements are met by field staff. The PC will ensure QAPP requirements are met by the laboratory. The FTL will notify the PM of any needed field CAs. The PM will notify the Navy NTR of any field quality issues that would negatively impact data quality or schedule. The PM will have 24 hours to respond to the request for field CA. CA with laboratories will be coordinated by PC. The PC will notify the Program Chemist, who will in turn notify the Navy NTR and Navy Chemist of any lab issues that render data quality objectives (DQOs) unattainable or cause delivery issues such that project schedule cannot be met.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Reporting Data Validation (DV) Issues	CH2M HILL Data Validator	Herb Kelly	352-384-7100	All completeness and data issues will be addressed with the laboratory. The Data Validator should copy the CH2M HILL PC on all communications to the laboratory. The validated data package will be due within 14 calendar days of data receipt by the validator.
DV CAs	CH2M HILL Data Validator, Program Chemist, and PC	Herb Kelly Anita Dodson Seng Camus	352-384-7100 757-671-6218 808-440-0231	The need for CA for DV issues will be determined by the CH2M HILL data validator, Program Chemist and PC, as necessary. These staff members will ensure that QAPP requirements are met by the analytical results. The PC will notify the PM of any needed DV CAs. The PM will have 48 hours to respond to the request for the DV CA. DV CAs will be coordinated by the PC in coordination with the CH2M HILL data validator and Program Chemist.
Technical communications for project implementation and data interpretation	CH2M HILL STC and AQM	Mike Skeeane John Tomik	704-543-3285 757-671-6259	The STC is contacted regarding questions/issues encountered in the field and input on data interpretation, as needed. The STC will have 24 hours to respond to technical field questions as necessary. AQM will also communicate strategies for ensuring that the approach for investigation and clean-up of individual NAS Oceana sites is consistent with the overall strategy for the cleanup of the base and its corresponding annexes.
Sample Receipt Variances	Laboratory PM	Jennifer Obrin (Katahdin) Kathryn Kelly (Test America) Renee McIsaac (EnviroSystem)	207-874-2400 x17 802-923-1021 603-926-3345 x209	All sample receipt variances will be communicated to the PC by the subcontracted laboratory within 1 day of discovery.
Reporting Lab Quality Variances	Laboratory PM	Jennifer Obrin (Katahdin) Kathryn Kelly (Test America) Renee McIsaac (EnviroSystem)	207-874-2400 x17 802-923-1021 603-926-3345 x209	All quality assurance (QA)/quality control (QC) issues with project field samples will be reported by the subcontracted laboratory, who will relay them to the PC and QAO within 2 days of discovery.

SAP Worksheet #7—Personnel Responsibilities Table

(UFP-QAPP Manual Section 2.4.3)

Title/Role	Organizational Affiliation	Responsibilities
Krista Parra / NTR	NAVFAC Mid-Atlantic	Coordinates all Environmental Restoration Program (ERP) activities and Munitions Response Program (MRP) activities at NAS Oceana
Steve Mihalko / RPM	VDEQ	Manages all aspects of the project to confirm state regulations and requirements are met
Bonnie Capito / Librarian	NAVFAC Atlantic	Responsible for document tracking and filing
Laura Cook / AM	CH2M HILL	Responsible for support to Navy to implement CERCLA ERP at NAS Oceana
Steve Falatko / MRM	CH2M HILL	Responsible for support to Navy to implement MRP at NAS Oceana
Joe Kenderdine / PM	CH2M HILL	Day-to-day project management to implement SAP. Directs and oversees staff; health, safety, and environment. Contractor point of contact (POC) for decision-making. Conducts data usability assessment.
Renee Hunt / TM	CH2M HILL	Aids in preparation of the SAP; prepares Attachments; coordinates with geographic information systems technicians, senior consultants, and publications; assists PM in planning and coordinating.
John Tomik / AQM	CH2M HILL	Provides activity-level quality review and guidance
Mike Skeeane / STC	CH2M HILL	Provides senior technical oversight
Bill Kappleman / Ecological Risk Assessor	CH2M HILL	Responsible for Ecological Risk Assessment (ERA) to determine any impacts to ecological receptors
Roni Warren / Human Health Risk Assessor	CH2M HILL	Responsible for Human Health Risk Assessment (HHRA) to determine any impacts to human receptors
Anita Dodson / Program Chemist	CH2M HILL	Provides program level review of the UFP-SAP and program-level support throughout the project duration
Seng Camus / PC	CH2M HILL	Performs oversight of laboratory and data validators, and evaluates usability of data. Manages sample tracking.
TBD / FTL	CH2M HILL	Supervises field sampling and coordinates all field activities
Herb Kelly / Data Validator	CH2M HILL	Responsible for the analytical data review and validation
Carl Woods / Health and Safety Officer (HSO)	CH2M HILL	Oversees Health and Safety (H&S) for CLEAN Program
Jennifer Obrin / Laboratory PM	Katahdin Laboratory	Responsible for Katahdin Laboratory analytical services
Kathryn Kelly / Laboratory PM	Test America	Responsible for Test America analytical services
Renee McIsaac / Laboratory PM	EnviroSystem	Responsible for EnviroSystem Laboratories analytical services

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SAP Worksheet #8—Special Personnel Training Requirements Table

[\(UFP-QAPP Manual Section 2.4.4\)](#)

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Fieldwork	Munitions and explosives of concern (MEC) Awareness Training (3R Training)	CH2M HILL UXO Technician	Before mobilization	All non-UXO technicians who will work at the site	FTL and SSC from CH2M HILL Field team members from subcontractor	Project folder

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SAP Worksheet #9a—Project Scoping Session Participants Sheet

[\(UFP-QAPP Manual Section 2.5.1\)](#)

Project Name: RI/FS for Skeet and Trap Range at DNA Projected Date(s) of Sampling: June 2014 PM: Joe Kenderdine				Site Name: Skeet and Trap Range Site Location: DNA, Virginia Beach, Virginia	
Date of Sessions: May 7, 2013 Scoping Sessions Purpose: Develop the RI sampling approach with the NAS Oceana Partnering Team.					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Krista Parra	NTR	NAVFAC Mid-Atlantic	757-341-0395	krista.parra@navy.mil	Representative of lead agency responsible for overseeing execution of project
Steve Mihalko	RPM	VDEQ	804-698-4202	stephen.mihalko@deq.virginia.gov	Lead representative of VDEQ, responsible for review of documents and to ensure that appropriate regulations are applied
Kyle Newman	Risk Assessor	VDEQ	804-698-4452	kyle.newman@deq.virginia.gov	VDEQ representative, responsible for review of investigation approach and risk assessment
Steve Falatko	MRM	CH2M HILL	703-376-5099	stephen.falatko@ch2m.com	Oversight of project delivery, technical support
Joe Kenderdine	PM	CH2M HILL	703-376-5156	joseph.kenderdine@ch2m.com	UFP-SAP production, project management
Renee Hunt	TM	CH2M HILL	414-847-0349	renee.hunt@ch2m.com	UFP-SAP production, project support
Bill Kappleman	Ecological Risk Assessor	CH2M HILL	703-376-5152	william.kappleman@ch2m.com	Senior technical support for ERA

Comments/Decisions:

The team discussed the historical site data and RI approach for the DNA Skeet and Trap Range. The Site Inspection (SI) identified potential human health and ecological risks at the Skeet and Trap Range. Based on the SI results, an RI is being planned for the site. The proposed RI approach includes a multi-phased approach with the following components: Pellet/clay target survey, Phase 1 investigation (surface and subsurface soil/sediment sampling), and potentially a Phase 2 investigation (additional surface and/or subsurface soil/sediment sampling to close data gaps, toxicity and tissue analysis, and groundwater sampling). The findings of the pellet/clay target survey, as well as the SI sampling results, will be used to select the Phase 1 sample locations. The results of the Phase 1 sampling effort would be evaluated to determine the need for, and scope of, the proposed Phase 2 samples.

The pellet/clay target survey will be conducted along 12 transects extending from the firing line across the range fan. Survey locations would be placed in the undeveloped portions of the site at 75-foot intervals on the internal transects and 150-foot intervals on the external transects for a total of approximately 95 survey locations. The external transects are defined as the two easternmost and two westernmost transects. Soil and/or sediment samples would be collected from areas of approximately 6-inches by 6-inches by 3 inches deep at each of the 95 survey locations. Soil and sediment samples associated with the pellet/clay target survey would be sieved to evaluate the presence of lead shot and clay target fragments at each location.

SAP Worksheet #9a—Project Scoping Session Participants Sheet (continued)

The Phase 1 sampling approach will be refined based on the findings of the pellet/clay target survey, which includes determining which samples will be analyzed for lead and/or polycyclic aromatic hydrocarbons (PAHs). The sample locations within the area that may have been impacted by the clay target fragments will be analyzed for PAHs, the locations within the area that may have been impacted by lead shot will be analyzed for lead. The initial Phase 1 sampling approach includes collection of the following samples:

- Surface soil samples from 20 locations within the range fan area and 5 background locations at a depth of 0-12 inches below ground surface (bgs) to be analyzed for lead and/or PAHs, pH, and total organic carbon (TOC).
- Subsurface soil samples co-located with the surface soil samples (including the background locations) at two subsurface intervals, 12-24 inches bgs and 24-48 inches bgs. Soil samples collected from the 24-48 inch interval will be held pending analysis of the 12-24 inch interval samples and will be analyzed if the sample results from the 12-24 inch interval exceed human health screening criteria. Subsurface soil samples will be analyzed for lead and/or PAHs. Soil samples from the 12-24 inch intervals will also be analyzed for pH and TOC. The 24-48 inch interval samples will not be analyzed for pH and TOC, as this depth will not be evaluated with respect to ecological receptors.
- Surface sediment samples from 15 locations within the range fan area and 5 background locations at a depth of 0-6 inches to be analyzed for lead and/or PAHs, pH, TOC, acid volatile sulfide (AVS)/ simultaneously extracted metals (SEM), and grain size.
- Sediment cores pushed by hand at each surface sediment sample location to a depth of 24 inches and inspected for stratification, grain size, and the presence of lead shot/clay targets. If the sediment core contains lead shot/clay targets within the subsurface interval, a subsurface sediment sample will be collected within the interval containing the lead shot/clay targets. The subsurface sediment samples will be analyzed for lead and/or PAHs.

The soil and sediment analyses for pH, TOC, AVS/SEM, and grain size will be used to help evaluate contaminant fate, transport, and bioavailability with regard to ecological receptors in the ERA, which will be conducted in accordance with United States Environmental Protection Agency (USEPA) and Navy ERA guidance. Pellet/clay target counts will also be conducted at each Phase 1 surface soil and sediment sample location to allow a direct comparison between chemical concentrations and the quantity of pellets/clay target fragments.

The Phase 2 sampling approach will be refined based on the findings of the Phase 1 investigation. For planning purposes, the team assumed that the Phase 2 sampling approach will include the collection of surface soil and sediment samples for toxicity testing and to close anticipated data gaps identified in the previous site data, fish and earthworm tissue samples, and groundwater samples. If the Phase 1 results indicate that all or some of the planned Phase 2 investigation activities are not needed for site characterization, these samples will not be collected. The tentative Phase 2 sampling approach includes collection of the following samples:

- Surface soil samples from 12 locations within the range fan and 3 reference locations at a depth of 0-12 inches bgs. Samples will be collected for lead and/or PAH analysis and toxicity testing. Soil samples will also be analyzed for pH and TOC. Pellet/clay target counts will also be conducted at each Phase 2 soil sample location.
- Surface sediment samples from 9 locations within the range fan and 3 reference locations at a depth of 0-6 inches. Samples will be collected for lead and/or PAHs analysis and toxicity testing. Sediment samples will also be analyzed for pH, TOC, AVS/SEM, grain size, sulfide, and ammonia. Pellet/clay target counts will also be conducted at each Phase 2 sediment sample location.

SAP Worksheet #9a—Project Scoping Session Participants Sheet (continued)

- Up to fifteen fish (whole-body and/or fillet) and up to 15 earthworm tissue samples will be collected and analyzed for lead.
- Six shallow permanent monitoring wells will be installed using direct-push technology (DPT) drilling methods and groundwater samples will be collected and analyzed for total and dissolved lead and/or PAHs. Five of the groundwater wells will be installed within the potentially impacted area and one well will be installed at an upgradient location.

Action Items:

1. Review USEPA ecological guidance related to contaminated grit particles (i.e., lead shot).

Resolution: The following ERA document was reviewed: Bennett, R., D. Hoff and M. Etterson. 2011. *Assessment of Methods for Estimating Risk to Birds from Ingestion of Contaminated Grit Particles*. U.S. Environmental Protection Agency, Ecological Risk Assessment Support Center, Cincinnati, OH. EPA/600/R-11/023. Based on a review of this document, no changes to the proposed RI approach are required. The pellet and clay target survey details will be presented in a work plan technical memorandum for team review before the survey is conducted.

2. Determine if Lake Tecumseh is manmade and tidally influenced.

Resolution: The Lake is not manmade. It is a shallow 261-acre lake located near the Atlantic Ocean. The water levels in the lake fluctuate due to wind-driven tides and a man-made canal connecting the lake to Back Bay estuary. Weirs were installed to reduce the release of suspended sediment from the lake into the Back Bay Estuary. (Reference: <http://www.fws.gov/northeast/virginiafield/partners/tecumseh.html>)

3. Contact the United States Fish and Wildlife Service (USFWS) to determine how they want to be informed of RI/FS activities.

Resolution: Mr. Will Smith of the USFWS Virginia Field Office was contacted on May 13, 2013, to brief him on the upcoming RI/FS activities. Mr. Smith wants to be kept informed but not an active participant. He would like to be copied on final reports. He was sent a figure showing the site location on Lake Tecumseh.

4. Proceed with conducting the pellet/clay target survey

Resolution: Prepare a Tech Memo to document the pellet/clay target survey approach.

Consensus Decisions:

The team agreed with the RI approach discussed during the scoping session as summarized above.

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SAP Worksheet #9b—Project Scoping Session Participants Sheet

[\(UFP-QAPP Manual Section 2.5.1\)](#)

Project Name: RI/FS for Skeet and Trap Range at DNA Projected Date(s) of Sampling: June 2014 PM: Joe Kenderdine				Site Name: Skeet and Trap Range Site Location: DNA, Virginia Beach, Virginia	
Date of Sessions: August 21, 2013 Scoping Sessions Purpose: Discuss the findings of the pellet/clay target survey and refine the Phase 1 RI approach					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Krista Parra	NTR	NAVFAC Mid-Atlantic	757-341-0395	krista.parra@navy.mil	Representative of lead agency responsible for overseeing execution of project
Steve Mihalko	RPM	VDEQ	804-698-4202	stephen.mihalko@deq.virginia.gov	Lead representative of VDEQ, responsible for review of documents and to ensure that appropriate regulations are applied
Kyle Newman	Risk Assessor	VDEQ	804-698-4452	kyle.newman@deq.virginia.gov	VDEQ representative, responsible for review of investigation approach and risk assessment
Steve Falatko	MRM	CH2M HILL	703-376-5099	stephen.falatko@ch2m.com	Oversight of project delivery, technical support
Joe Kenderdine	PM	CH2M HILL	703-376-5156	joseph.kenderdine@ch2m.com	UFP-SAP production, project management
Renee Hunt	TM	CH2M HILL	414-847-0349	renee.hunt@ch2m.com	UFP-SAP production, project support
Bill Kappleman	Ecological Risk Assessor	CH2M HILL	703-376-5152	william.kappleman@ch2m.com	Senior technical support for ERA

Comments/Decisions:

The team discussed the findings of the June 2013 pellet/clay target survey and refined the Phase 1 sampling approach. During the June 2013 pellet/clay target survey, 107 locations (44 surface soil and 63 sediment) were surveyed for the presence of lead shot and clay target fragments. Lead pellets were identified at 15 of the 44 soil locations and at 28 of the 63 sediment locations. Clay target fragments were present at 5 of the 44 soil locations and 4 of the 63 sediment locations.

The results of the SI and the 2013 pellet/clay target survey were evaluated to refine the proposed Phase 1 sampling approach. The modified Phase 1 sampling approach includes the following:

Surface soil samples from approximately 27 locations within the range fan at a depth of 0-12 inches bgs. Subsurface soil samples will be co-located with the surface soil samples at two subsurface intervals, 12-24 inches bgs and 24-48 inches bgs. Samples from the 24-48 inch interval will not be held pending analysis of the 12-24 inch samples, and instead will be analyzed with the other samples as the team felt that data from the 24-48 inch interval will be needed and due to holding time issues for PAHs. Of the estimated 27 total site soil samples, approximately 24 samples will be analyzed for lead, and 12 samples will be analyzed for PAHs.

SAP Worksheet #9b—Project Scoping Session Participants Sheet (continued)

This determination was based on the estimated extent of clay target fragments (for PAH analysis) and lead shot (for lead analysis) within the investigation area. Background soil samples (five locations) will be analyzed for both lead and PAHs. All soil samples within the 0-12 inch and 12-24 inch intervals will be analyzed for pH, and soil samples at these depths analyzed for PAH will also be analyzed for TOC.

- Sediment samples from approximately 21 locations within the range fan at a depth of 0-6 inches. Of the estimated 21 total site surface sediment samples, approximately 21 samples will be analyzed for lead and 7 samples will be analyzed for PAHs. This determination was based on the estimated extent of clay target fragments (for PAH analysis) and lead shot (for lead analysis) within the investigation area. Background sediment samples (five locations) will be analyzed for both lead and PAHs. All surface sediment samples will be analyzed for pH, AVS/SEM, and grain size, and sediment samples analyzed for PAHs will also be analyzed for TOC. Sediment cores will be pushed by hand at each surface sediment sample location to a depth of 24 inches. Cores will be inspected for stratification, grain size, and the presence of lead shot/clay targets. If the sediment core contains lead shot/clay targets within the subsurface interval, a subsurface sediment sample will be collected within the interval containing the lead shot/clay targets.
- Subsurface sediment samples will be analyzed for lead and/or PAHs based on the presence of lead shot/clay targets within the sediment cores.
- Pellet/clay target counts will be completed at each Phase 1 surface soil and surface sediment sample location.

During the discussion, Steve Mihalko asked why no sediment samples were proposed within the furthest extent of the maximum theoretical shotfall zone. CH2M HILL indicated that the RI sample locations were selected based on the pellet/clay target survey, which did not identify lead shot in the western portion of the shotfall zone, and the SI results. Based on this information, the nature and extent of lead impacts in the western portion of the shotfall zone have been delineated. Steve Mihalko concurred with this approach.

During the discussion, Kyle Newman asked what activities were performed in the building west of the proposed background locations. Krista Parra indicated that the building is administrative and used for training purposes. Kyle also questioned how long Regulus Avenue has been at its current location. CH2M HILL responded that the road is present in 1945 aerial photographs. Kyle requested that the background samples be collected from the woods and not in the grassy area adjacent to the roadway. Additionally, Kyle requested that two of the five background soil locations be located within the area of standing water near transects 10 and 11 and outside the range fan boundary. The Partnering Team agreed with this placement of background samples.

No modifications were made to the Phase 2 sampling approach that was agreed upon during the May 7, 2013, scoping session.

Action Items:

1. Joe Kenderdine (CH2M HILL PM) requested feedback from VDEQ by August 23, 2013, regarding the proposed sample locations.

Resolution: VDEQ concurrence on the proposed sampling locations was received on August 23.

Consensus Decisions:

The team agreed with the revised RI sampling approach.

SAP Worksheet #9c—Project Scoping Session Participants Sheet

[\(UFP-QAPP Manual Section 2.5.1\)](#)

Project Name: RI/FS for Skeet and Trap Range at DNA Projected Date(s) of Sampling: June 2014 PM: Joe Kenderdine				Site Name: Skeet and Trap Range Site Location: DNA, Virginia Beach, Virginia	
Date of Sessions: December 11 and 12, 2013 (e-mail communications) Scoping Sessions Purpose: Development of revised soil and sediment background approach					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Krista Parra	NTR	NAVFAC Mid-Atlantic	757-341-0395	krista.parra@navy.mil	Representative of lead agency responsible for overseeing execution of project
Steve Mihalko	RPM	VDEQ	804-698-4202	stephen.mihalko@deq.virginia.gov	Lead representative of VDEQ, responsible for review of documents and to ensure that appropriate regulations are applied
Steve Falatko	MRM	CH2M HILL	703-376-5099	stephen.falatko@ch2m.com	Oversight of project delivery, technical support
Joe Kenderdine	PM	CH2M HILL	703-376-5156	joseph.kenderdine@ch2m.com	UFP-SAP production, project management
Renee Hunt	TM	CH2M HILL	414-847-0349	renee.hunt@ch2m.com	UFP-SAP production, project support

Comments/Decisions:

The team developed a modified approach to evaluating soil and sediment background concentrations via e-mail. After further evaluation of the previously developed background approach, it was determined that multiple soil types are present within the Skeet and Trap Range boundary, and the agreed upon sampling approach may not be sufficient to evaluate site background conditions. A revised approach was developed to evaluate background soil and sediment concentration at the Skeet and Trap Range and is described in the following paragraphs.

As base-specific background data are not available for DNA, an evaluation of site-specific contaminant concentrations is planned to determine the lead and PAH concentrations naturally occurring or from anthropogenic sources unrelated to Skeet and Trap Range activities. To identify potential background ranges for lead and PAHs, a graphical interpretation of the analytical results will be performed in accordance with *Guidance for Environmental Background Analysis (Volume I: Soil)* (NAVFAC, 2002), *Guidance for Environmental Background Analysis (Volume II: Sediment)* (NAVFAC, 2003), and the recent paper by ProUCL author Anita Singh (Singh, 2013). With this modified approach, no background samples will be collected during Phase 1 of the RI as originally planned.

Data points impacted by site activities and not impacted by site activities are anticipated to be present within the combined site data sets (Expanded SI and Phase 1 RI). Following the Phase 1 RI effort, the data sets from the Expanded SI and RI will be combined, and probability plots will be generated to evaluate changes in slope (inflection points) or break points in the data to determine a suitable range of background concentrations for lead and PAHs in site soil and sediment. These probability plots will be generated for lead in soil, lead in sediment, total PAHs in soil, and total PAHs in sediment. The data within the identified background concentration range will then be used to calculate a statistic known as the background threshold value (BTV). The identified background ranges and calculated BTVs will be presented to the Partnering Team, and team concurrence will be obtained.

SAP Worksheet #9c—Project Scoping Session Participants Sheet (continued)

Once team concurrence has been obtained, the BTVs for each data set will be used to evaluate whether site concentrations are indicative of site contamination or background conditions. If a BTV cannot be agreed upon, additional site-specific background sampling may be performed during Phase 2 of the RI.

SAP Worksheet #10—Conceptual Site Model

[\(UFP-QAPP Manual Section 2.5.2\)](#)

Dam Neck Annex Site Description

The primary mission of NAS Oceana and its outlying fields is to support the Navy's Atlantic and Pacific Fleet force of strike-fighter aircraft and joint/interagency operations. DNA is home to the Fleet Combat Training Center Atlantic (FCTCLANT) and other tenant commands. The mission of this installation is to provide force-level engineering solutions, mission-critical and associated testing, and training technologies for the maritime, joint, special warfare, and information operations domains (Malcolm-Pirnie, 2008).

DNA is located in the southeastern portion of Virginia Beach, Virginia, and encompasses 1,372 acres (**Figure 1**). DNA is bounded by Virginia Beach to the west, the community of Sandbridge to the south, and the Atlantic Ocean to the east. Camp Pendleton adjoins DNA to the north.

Skeet and Trap Range Site Description

The Skeet and Trap Range is located on the southwestern portion of DNA, on the eastern shore of Lake Tecumseh. The range was situated along the northern side of Bullpup Street and west of Regulus Avenue in Virginia Beach, Virginia (**Figure 2**). Approximately half of the range fan extends over Lake Tecumseh, which is currently owned by the HRSD.

The Skeet and Trap Range was utilized during the 1940s and 1950s and was composed of four skeet and four trap shooting positions. Based on historical aerial photographs, the firing line was located north of Bullpup Street with the direction of fire toward the northwest over Lake Tecumseh (Malcolm Pirnie, 2008). The range fans associated with this site cover approximately 39 acres and are identified as the Surface Danger Zone. The southeast portion of the site has been developed into Building 470 and a parking lot. The remaining portion is composed of undeveloped forest and open water (Lake Tecumseh).

Ammunition used at the Skeet and Trap Range is expected to be 12 gauge or smaller shotgun ammunition. The primary contaminant associated with shotgun ammunition is lead. PAHs are also potential contaminants as they are used as a binder within the clay targets. A three-dimensional depiction of the Skeet and Trap Range conceptual site model (CSM) is presented on **Figure 3**. Surface site features and potential receptors and exposure routes are presented on the CSM.

Previous Investigation Findings

During a site reconnaissance by Malcolm Pirnie in December 2007, clay target fragments were observed along the shoreline, in the wooded area adjacent to Bullpup Street and the parking lot, and in the shallow waters of Lake Tecumseh. Additionally, an abandoned building foundation was observed in the forested area, shown as the Skeet Shed Structure on **Figure 2** that is believed to have been used as a skeet or trap launching point (Malcolm Pirnie, 2008). Potential sources of contamination identified at the range were debris related to small arms ammunition.

In 2010 and 2011, a Revised SI was performed at the Skeet and Trap Range. During the Revised SI, lead shot and clay target fragments were observed in site soil and sediment. Surface soil and sediment samples were collected and analyzed for lead and/or PAHs. Human health and ecological risk screenings were performed. Lead and PAHs were identified as constituents of potential concern (COPCs) in surface soil for human and ecological receptors. Lead was also identified as a COPC in surface sediment for ecological receptors (CH2M HILL, 2012). **Figures 4 and 5** present the Human Health and Ecological Screening Value (ESV) exceedances for lead and PAHs. Elevated lead concentrations were observed in soils throughout the range fan boundary, while lead exceedances in sediment were more sporadic and were primarily within the theoretical maximum shotfall zone.

PAH detections exceeding screening values in soil were observed throughout the range fan boundary, but concentrations were highest in the immediately vicinity of the skeet range firing positions. There were no PAH exceedances in site sediment.

SAP Worksheet #10—Conceptual Site Model (continued)

In 2013, a pellet/clay target survey was performed at the Skeet and Trap Range to evaluate the presence of lead shot and clay target fragments in surface soil and sediment. Soil and sediment samples were collected from survey locations on 12 transects that extended across the undeveloped portions of the range fan from the firing line to the range fan boundary (**Figure 6**). Soil and sediment survey locations were collected at 75-foot intervals along the internal transects and at 150-foot intervals along the external transects for a total of 107 survey locations. A total of 44 surface soil locations and 63 sediment locations were surveyed.

Lead pellets were present at 15 out of 44 soil locations and at 28 locations out of the 63 sediment locations. The highest number of lead pellets were identified, as expected, at locations between the firing line and the extent of the theoretical maximum shotfall zone. Clay target fragments were present in 5 surface soil locations out of the 44 sampled and in 4 sediment locations out of the 63 sampled locations. Clay target fragments were identified in close proximity to the historical firing positions. **Figures 7 and 8** presents the lead pellet and clay target findings, respectively. The lead pellet and clay target locations correlate with the distribution of lead and PAH exceedances observed during the Expanded SI.

Geological and Hydrogeological Setting

Geology

DNA is located within the Atlantic Coastal Plain physiographic province, which is underlain with unconsolidated sediments generally of Quaternary ages. These surficial deposits include undivided sand, clay, gravel, and peat, which were deposited in marine, fluvial, aeolian, and lacustrine environments (Malcolm Pirnie, 2008).

Hydrology

Surface water runoff from the Skeet and Trap Range flows to Lake Tecumseh. Lake Tecumseh, also known as Brinson Lake Inlet, forms the southern boundary of DNA. Lake Tecumseh is connected to Redwing Lake through an open drainage channel, which connects to Back Bay (Malcolm Pirnie, 2008).

Hydrogeology

The shallow aquifer system in Virginia Beach is composed of the Columbia aquifer, Yorktown confining unit, and the Yorktown-Eastover aquifer. The Columbia aquifer includes predominantly sandy surficial deposits and generally extends from the ground surface to approximately 20 feet below mean sea level. The Columbia aquifer is generally unconfined but clayey beds and lenses within the unit may produce leaky or confined conditions. The Columbia aquifer is underlain by the Yorktown confining unit, below which is the Yorktown-Eastover aquifer. The Yorktown-Eastover aquifer generally lies 90 feet bgs and ranges from 100 to 280 feet thick (Malcolm Pirnie, 2008). Site-specific groundwater data are not available as groundwater at the Skeet Range has not been previously investigated.

Soil and Vegetation Setting

Previous investigations indicate that the soils at the Skeet and Trap Range consist of udorthents, loam, and Nimmo loam. The developed portions of the site consist of landscaped, mowed, and cleared areas. The vegetated portion of the Skeet and Trap Range consists of forested wetlands that are dominated by pine and hardwood species. Pine and hardwood types are dominated by loblolly pine with red maple and sweetgum interspersed throughout. The understory includes red maple and sweetgum saplings, as well as wax myrtle, sweetbay magnolia (*Magnolia virginiana*), and redbay. Greenbrier, Japanese honeysuckle, and poison ivy are prevalent vines (Malcolm Pirnie, 2008).

Potential Exposure and Receptor Pathways

A three-dimensional depiction of the Skeet and Trap Range at DNA is presented in the CSM shown on **Figure 3**. Site features, and potential receptors and exposure routes are presented on the CSM.

SAP Worksheet #10—Conceptual Site Model (continued)

Potential contaminant transport pathways include weathering of lead shot and clay target fragments over time and subsequent leaching of lead and PAHs, respectively, to soil and sediment. Transport of lead and/or PAHs into the ground by infiltration may also impact subsurface soil and groundwater. The potential receptors considered in this CSM include current/future industrial workers, current/future trespassers and visitors, current/future recreational users (anglers), future construction workers, future residents, and terrestrial and aquatic ecological receptors (such as birds, mammals, reptiles, fish, amphibians, aquatic and soil invertebrates, and aquatic and terrestrial plants). Potential exposure pathways for human receptors include ingestion of, dermal contact with, and inhalation of particulate emissions from surface and subsurface soil; ingestion of and dermal contact with groundwater and sediment; and ingestion of fish. Potential exposure pathways for ecological receptors include direct contact with, root uptake (plants) of, and ingestion (both direct and incidental) of site media, and exposure via food webs.

Data Gaps and Additional Ecological Assessments

The project quality objectives (PQOs) and environmental questions (**Worksheet #11**) consider those media, potential sources, and transport mechanisms, associated with historical Skeet and Trap Range activities in order to gain a complete understanding of the CSM. An investigation to address the following data gaps at the Skeet and Trap Range will be performed during the sampling effort outlined in this UFP-SAP:

- Surface and subsurface soils – Previous site investigation activities identified lead and PAHs in surface soil at concentrations exceeding human health and ecological risk criteria. Additionally, lead shot and clay target debris have been observed on the ground surface. The extent of lead and PAH contamination in site soils has not been delineated. Surface soil samples have been proposed to fill the data gaps identified following review of the Expanded SI and the pellet/clay target survey results and to further refine the horizontal extent of contamination within site soil. Subsurface soil samples have been proposed to evaluate the vertical extent of contamination within site soil.
- Surface and subsurface sediment – Previous site investigation activities identified lead and PAHs in surface sediment at concentrations exceeding ecological risk criteria. Additionally, lead shot and clay target debris have been observed in surface sediment. The extent of lead and PAH contamination in surface sediment has not been delineated. Surface sediment samples have been proposed to fill the data gaps identified following review of the Expanded SI and the pellet/clay target survey results and to further refine the horizontal extent of contamination within site sediment. Subsurface sediment samples may be collected to evaluate the vertical extent of contamination within site sediment if sediment cores identify pellet/clay target debris within subsurface sediment.
- Groundwater – Possible impacts to site groundwater have not been previously investigated. If subsurface soil samples results indicate that contaminants may be impacting site groundwater, groundwater samples will be proposed in areas of possible contamination to investigate this potential contaminant pathway.

The Expanded SI data identified lead and PAHs as COPCs for human and ecological receptors. Following the RI sampling, quantitative risk assessments will be performed for human and ecological receptors. Toxicity testing and tissue sampling of fish and earthworms may also be performed in soil and sediment if Phase I RI data indicates that these analyses are necessary for additional site characterization. Ecological impacts due to direct ingestion of lead shot in upland areas will also be modeled using the pellet/clay target data.

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SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

[\(UFP-QAPP Manual Section 2.6.1\)](#)

Problem Definition/Objective, Environmental Questions, and PQOs			
Problem Definition/ Objective	Environmental Question	General Investigation Approach	PQO
Determine the nature and extent of lead and PAHs in soil and sediment and evaluate potential impacts on site receptors.	What are the nature and extent of lead and PAH contamination in soil associated with Skeet and Trap Range activities?	During the Phase 1 RI, surface soil samples (0-12 inches) and subsurface soil samples (12-24 inches and 24-48 inches) will be collected at approximately 27 locations to fill data gaps and further delineate lead and PAHs in soil. The Revised SI data and the results of the pellet/clay target survey were used to determine which samples are to be analyzed for lead and/or PAHs by evaluating the estimated impacts of the clay target fragments (for PAH analysis) and lead shot (for lead analysis). Figures 9 and 10 present proposed soil sampling locations for lead and PAHs, respectively. A pellet/clay target count will be performed at each surface soil sample location using the same methods employed during the initial field survey to allow a direct comparison between chemical concentrations and the quantity of pellets/clay target fragments.	<p>If the nature and extent of site contamination in soil has been determined or can be reasonably estimated based on the Phase 1 sampling results, the RI Report will be completed, risks will be assessed, and evaluation of a path forward for the site will be completed.</p> <p>If the nature and extent has not been reliably determined or cannot be reasonably estimated based on the Phase 1 sampling results, additional investigation activities will be performed during the Phase 2 effort to accomplish this objective.</p> <p>Team consensus will be obtained to determine that Phase 1 data collection activities are complete and prior to implementation of the Phase 2 investigation.</p>
	What are the nature and extent of lead and PAH contamination in sediment associated with Skeet and Trap Range activities?	<p>During the Phase 1 RI, surface sediment samples (0-6 inches) will be collected at approximately 21 locations to fill data gaps and further delineate lead and/or PAHs in sediment. The spatial distribution of lead and PAH contamination within the range fan area varies with lead observed mostly throughout the range fan and PAHs located closer to the historical firing line. The Revised SI data and the results of the pellet/clay target survey were used to determine which samples are to be analyzed for lead and/or PAHs by evaluating the estimated impacts of the clay target fragments (for PAH analysis) and lead shot (for lead analysis). Figures 9 and 10 present proposed sediment sampling locations for lead and PAHs, respectively. A pellet/clay target count will be performed at each surface sediment sample location using the same methods employed during the initial field survey to allow a direct comparison between chemical concentrations and the quantity of pellets/clay target fragments.</p> <p>Sediment cores (0 to 24 inches) will be pushed by hand, and each core will be evaluated for stratigraphy, grain size, and the presence of lead shot/clay target fragments. If the sediment core indicates a potential for contamination in the subsurface interval, a subsurface sediment sample will be collected at that location. Subsurface sediment samples will be analyzed for lead and/or PAHs based on the presence of lead shot/clay targets within the sediment cores.</p>	<p>If the nature and extent of site contamination in sediment has been determined or can be reasonably estimated based on the Phase 1 sampling results, the RI Report will be completed, risks will be assessed, and evaluation of a path forward for the site will be completed.</p> <p>If the nature and extent has not been reliably determined or cannot be reasonably estimated based on the Phase 1 sampling results, additional investigation activities will be performed during the Phase 2 effort to accomplish this objective. Team consensus will be obtained to determine that Phase 1 data collection activities are complete and prior to implementation of the Phase 2 investigation.</p>

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

[\(UFP-QAPP Manual Section 2.6.1\)](#)

Problem Definition/Objective, Environmental Questions, and PQOs			
Problem Definition/ Objective	Environmental Question	General Investigation Approach	PQO
	What are the background levels of lead and PAHs in soil and sediment in the vicinity of the site that are not attributable to skeet and trap range activities?	During the Phase 1 RI, a graphical interpretation of the Skeet range data will be performed in accordance with <i>Guidance for Environmental Background Analysis</i> (NAVFAC, 2002) to identify potential background ranges for lead and PAHs. A segmented probability plot review will be used to identify the different populations. The probability plots will be generated to evaluate changes in slope (inflection points) to determine background ranges for lead and PAHs in site soil and sediment	The identified background ranges will be presented to the Partnering Team, and team concurrence regarding use of this background range will be obtained. Once team concurrence of the background range has been obtained, calculated BTVs for each data set will be used to evaluate whether site concentrations are indicative of site contamination or background conditions. If a BTV cannot be agreed upon, additional site-specific background sampling may be performed during Phase 2 of the RI.
	Do contaminant levels in soil and sediment pose an unacceptable risk to current or future receptors?	After the Phase 1 sampling efforts have been completed, human health and ecological risk screenings will be performed for soil and sediment to assess risks to current and future receptors and determine the need for Phase 2 sampling.	<p>Following the completion of Phase 1 sampling and data validation, a Technical Memorandum will be prepared to summarize the Phase 1 investigation findings and the results of the human health and ecological risk screenings. The Phase 1 Technical Memorandum will be used by the Partnering Team to help determine the need for any Phase 2 sampling, and, if needed, to support development of the Phase 2 scope and sampling approach.</p> <p>If contaminant levels in soil and sediment do not pose an unacceptable risk to human and ecological receptors based on the risk screenings in the Phase 1 Technical Memorandum, the RI/FS Report will be prepared and summarize the investigation findings and propose no future action for those media.</p>

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

[\(UFP-QAPP Manual Section 2.6.1\)](#)

Problem Definition/Objective, Environmental Questions, and PQOs			
Problem Definition/ Objective	Environmental Question	General Investigation Approach	PQO
	Following the Phase 1 RI, is further characterization of site media needed to evaluate potential impacts to site groundwater?	Following the Phase 1 RI sampling, soil and sediment data will be evaluated to determine whether Phase 2 RI sampling of site groundwater will be needed. If subsurface soil concentrations indicate that lead and/or PAHs may have impacted site groundwater at concentrations exceeding human health criteria, characterization of groundwater will be performed.	<p>Potential impacts to groundwater will be evaluated by comparing the detected concentrations of lead and PAHs against soil screening levels (SSLs) from current EPA RSL tables for soil-to-groundwater leachability. Concentrations detected in soil in excess of SSLs and BTV (e.g., lead) will be used for identification of exceedances. As the SSLs with a dilution attenuation factor (DAF) of 1.0 (assumes no dilution or attenuation) are very conservative, other lines of evidence will be considered in identifying a need for further sampling for potential impacts to groundwater. The other lines of evidence, such as the mobility of the constituent, site specific release, and extent of exceedance (number of locations exceeding, depth of soil exceedance versus site groundwater depth, and how much higher the detected concentrations are than the SSL), will be considered in the determination of the need to collect groundwater samples. If the exceedance is small (for example, a low concentration, only a small percentage of the samples exceed the SSLs, deeper soil samples show no detections, and detections exceed by less than an order of magnitude), then groundwater sampling will not be necessary.</p> <p>If additional investigation is needed to evaluate potential groundwater impacts, site data will be evaluated to determine groundwater sampling locations for the Phase 2 RI effort. Team consensus will be obtained prior to execution of the Phase 2 investigation.</p>
	Is there potential for exposure to upper level trophic terrestrial ecological receptors (birds) from direct ingestion of lead shot?	<p>A pellet/clay target count will be performed at each Phase I surface soil sample location using the same methods employed during the initial field survey to allow a direct comparison between chemical concentrations in soil and the quantity of pellets/clay target fragments, as well as to evaluate direct ingestion of lead shot by terrestrial avian receptors. Direct ingestion of lead shot will be evaluated using the model described in <i>Assessment of Methods for Estimating Risks to Birds from Ingestion of Contaminated Grit Particles</i> (USEPA, 2011). The characterization of the number of grit particles that are lead shot will use the methods described in <i>Ecological and Human Health Risks at an Outdoor Firing Range</i> (Pedicord and LaKind, 2000) and will be performed on three composite site surface soil samples.</p>	<p>If the presence of lead shot in surface soil poses an unacceptable risk to ecological receptors through direct ingestion, the RI Report will summarize the investigation findings and propose a path forward to address unacceptable risks.</p> <p>If the presence of lead shot does not pose an unacceptable risk to receptors through direct ingestion, the RI Report will summarize the investigation findings and no additional evaluation of the direct ingestion pathway will be proposed.</p>

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

[\(UFP-QAPP Manual Section 2.6.1\)](#)

Problem Definition/Objective, Environmental Questions, and PQOs			
Problem Definition/ Objective	Environmental Question	General Investigation Approach	PQO
If soil data indicate site activities have impacted shallow groundwater, determine the extent of the impacts.	What are the nature and extent of lead and PAH contamination in groundwater associated with Skeet and Trap Range activities?	If Phase 2 RI sampling is warranted for groundwater, approximately six shallow permanent groundwater monitoring wells will be installed to evaluate the contamination distribution in groundwater in the vicinity of the Skeet and Trap Range. At least one of the installed wells will be located upgradient of the site to evaluate background groundwater concentrations. Groundwater will be sampled and analyzed for total and dissolved lead and/or PAHs based on the results of the Phase 1 RI effort. Site groundwater data will be compared to the upgradient groundwater sample to determine whether contaminant concentrations in site groundwater are associated with skeet range activities.	If the nature and extent of site contamination in groundwater has been reliably determined or can be reasonably estimated based on the results of the field investigation and laboratory analysis, the RI/FS report will be completed, risks will be assessed, and evaluation of a path forward for the site will be completed. If the nature and extent have not been reliably determined or cannot be reasonably estimated based on the results of the field investigation and laboratory analysis, additional investigation activities will be proposed to accomplish this objective to be implemented after team consensus is reached.
	What is the site lithology and how might it affect contaminant transport at the site?	If Phase 2 groundwater sampling is warranted, continuous soil cores will be collected and characterized during installation of approximately 6 shallow permanent groundwater monitoring wells to characterize the soil lithology.	The soil lithology and groundwater data will be used to update the site CSM and provide a better understanding of potential contamination migration at the site.
	What is the depth to groundwater and directions of groundwater flow at the Skeet and Trap Range?	If Phase 2 groundwater sampling is warranted, approximately six shallow permanent groundwater monitoring wells will be installed to determine the depth to groundwater and to provide a sufficient number of data points to determine the groundwater flow direction at the site.	
	Do contaminant levels in groundwater pose an unacceptable risk to current or future receptors?	After the Phase 2 sampling effort has been completed, a HHRA will be performed for groundwater to assess risks to current and future receptors.	If contaminant levels in groundwater pose an unacceptable risk to receptors, the RI/FS Report will summarize the investigation findings and propose a path forward to address unacceptable risks. If contaminant levels in groundwater do not pose an unacceptable risk to receptors, the RI/FS Report will summarize the investigation findings and propose no future action for that media.
Determine if site media (surface soil and surface sediment) is directly toxic to representative ecological receptors.	Is the site surface soil and/or surface sediment directly toxic (relative to reference locations) to representative ecological receptors?	If Phase 2 toxicity testing is warranted, toxicity tests will be conducted on earthworms (for soil) and/or invertebrates (for sediment). Endpoints will be survival, growth, and/or reproduction. Soil or sediment samples will be collected and analyzed for the constituents of concern (COCs) and appropriate physical parameters at each toxicity sampling location.	If toxicity in site samples is demonstrated at levels that are statistically higher than in reference samples, the RI/FS Report will summarize the investigation findings and propose a path forward to address unacceptable risks. If contaminant levels do not pose a risk to receptors, the RI/FS Report will summarize the investigation findings and propose no future action for the portion of the site associated with the Skeet and Trap Range.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

[\(UFP-QAPP Manual Section 2.6.1\)](#)

Problem Definition/Objective, Environmental Questions, and PQOs			
Problem Definition/ Objective	Environmental Question	General Investigation Approach	PQO
Determine if lead is bioaccumulating in earthworms to levels that may cause an unacceptable risk to ecological receptors that consume them.	What are the lead concentrations in the tissues (whole body) of earthworms that occur at the site?	If Phase 2 earthworm tissue sampling is warranted, earthworms will be field collected to evaluate potential impacts from historical site activities. The resulting concentrations will be used in ecological food web models to determine if the concentrations pose a potential risk to upper trophic level receptors that may consume them.	If contaminant levels in earthworms pose a risk to receptors, the RI/FS Report will summarize the investigation findings and propose a path forward to address unacceptable risks. If contaminant levels in earthworms do not pose a risk to receptors, the RI/FS Report will summarize the investigation findings and propose no future action for this potential pathway.
Determine if lead is bioaccumulating in fish to levels that may cause an unacceptable risk to human and/or ecological receptors.	What are the lead concentrations in the tissues (whole body and fillet) of fish that occur at the site?	If Phase 2 fish tissue sampling is warranted, fish tissue samples will be collected and analyzed to evaluate potential impacts from historical site activities. The species selected will be determined following a reconnaissance survey to determine the species and size classes of fish that are present. Both whole body (in the size range consumed by piscivorous wildlife) and fillet (edible sized fish for human consumption) samples will be collected. The resulting concentrations will be used in human health (fillet data) and ecological (whole body) ingestion models to determine if the concentrations pose a potential risk to receptors that may consume them. In addition, tissue concentrations in whole body fish will be compared with available tissue residue ESVs.	If contaminant levels in fish pose an unacceptable risk to receptors, the RI/FS Report will summarize the investigation findings and propose a path forward to address unacceptable risks. If contaminant levels in fish do not pose an unacceptable risk to receptors, the RI/FS Report will summarize the investigation findings and propose no future action for this potential pathway.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Who will use the data?

The data will be used by the Navy (and its contractors) and the regulatory agencies. Once published in the Administrative Record for the site, the data will be available to the public.

What are the Project Action Limits and Project Indicator Levels?

Project action limits (PALs) are medium-specific standards and criteria chosen for evaluation to help provide a conservative assessment of site conditions and to identify COPCs that are to be considered for quantitative risk calculations. The following list presents a summary of the PALs for each medium. **Worksheets #15-1 through #15-3** present the PALs for each constituent in each medium. Unless otherwise noted, the screening values used will be the most currently published values available.

Soil data will be screened against the PALs, which are based on the following human health and ESVs:

- Human Health Screening Criteria for Soil – USEPA regional screening levels (RSLs). RSLs based on non-carcinogenic effects will be based on a hazard quotient of 0.1 to account for exposure to more than one constituent that affects the same organ.
- ESVs for Surface and Shallow Subsurface Soil (0 to 24 inches bgs) – USEPA Eco-SSLs (only soil data in the specified depth range will be screened against ESVs).

Sediment data will be screened against the PALs, which are based on the following human health and ESVs:

- Human Health Screening Criteria for Sediment – USEPA Residential Soil RSLs x 10. RSLs based on non-carcinogenic effects will be based on a hazard quotient of 0.1 to account for exposure to more than one constituent that affects the same organ.
- ESVs for Freshwater Sediment – Values from the literature compiled for use at NAS Oceana and DNA (freshwater); see Appendix B.

Groundwater data, if collected, will be screened against the PALs, which are based on the following human health screening values:

- Human Health Screening Criteria for Groundwater – USEPA Tap Water RSLs. RSLs based on non-carcinogenic effects will be based on a hazard quotient of 0.1 to account for exposure to more than one constituent that affects the same organ.
- Maximum contaminant levels (MCLs) - Groundwater data also will be screened against the federal MCLs to assist in the nature and extent of contamination evaluation. The MCL will be used as the PAL if it is lower than the RSL. The lower of the RSL and MCL will be used as the PAL.

Soil, sediment, and groundwater data also will be compared to background data for the site to help distinguish site-related contaminants from background constituent concentrations. Further, the determination of presence of contamination (versus background) will take into consideration professional judgment evaluations such as nature of the constituents versus those likely released, presence of other constituents in the dataset, and magnitude and frequency of exceedance.

As base-specific background data are not available for DNA, a graphical interpretation of the site data will be performed in accordance with *Guidance for Environmental Background Analysis* (NAVFAC, 2003) and the paper by ProUCL author Anita Singh (Singh, 2013) to identify potential background ranges for lead and PAHs. As both site-impacted and non-site-impacted data points are anticipated to be present within the combined site data set (Expanded SI and Phase 1 RI data), a segmented probability plot review will be used to identify the different

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

populations. Following the Phase 1 RI effort, probability plots will be generated to evaluate changes in slope (inflection points) or break points in the data to determine background ranges for lead and PAHs in site soil and sediment. Probability plots will be generated for lead in soil, lead in sediment, total PAHs in soil, and total PAHs in sediment, and a contaminant threshold value will be sought for that dataset to identify the background concentration range. The identified background range will be presented to the Partnering Team, and team concurrence regarding use of this background range will be obtained. Once team concurrence of the background range has been obtained, calculated BTVs for each data set will be used to evaluate whether site concentrations are indicative of site contamination or background conditions. If a BTV cannot be agreed upon, additional site-specific background sampling may be performed during Phase 2 of the RI.

Background groundwater samples will be collected from at least one upgradient monitoring well, if groundwater sampling is performed. The upgradient analytical data will be compared with the site groundwater data to evaluate whether contaminant concentrations in site groundwater are related to former skeet range activities.

Site soil and sediment toxicity test sample results, if toxicity tests are conducted, will be statistically compared to site-specific reference sample results to evaluate the impact of site-related constituents on test organisms. The results of control samples will also be compared with test-specific minimum requirements for test validity.

Concentrations in site earthworm tissue samples, if collected, will be compared to those found in reference samples and also used in ecological food web models.

Fish tissue samples, if collected, will be screened against the PALs, which are based on the following human health and ESVs:

- Human Health Screening Criteria for Fish – USEPA fish tissue RSLs, calculated using the RSL Table calculator tool. RSLs based on non-carcinogenic effects will be based on a hazard quotient of 0.1 to account for exposure to more than one constituent that affects the same organ.
- ESVs for Whole-Body Fish – Literature-based fish tissue residue screening values for applicable freshwater fish species. Whole-body fish tissue samples will also be used in ecological food web models.

In instances where a laboratory's limit of detection (LOD) for a specific constituent will be greater than the corresponding PAL, any detection of this constituent above the LOD will be considered an exceedance of the associated PAL. In those cases where this specific constituent is not detected, the analyte will be considered not present at the LOD. In efforts to reach lower limits, the laboratory will report concentrations between the limit of quantitation (LOQ) and detection limit (DL) as estimated. These results will have a J qualifier applied to them.

Project indicator levels (PILs) are medium-specific standards and were developed to evaluate the fate and transport of contaminants with regard to ecological receptors. PILs are summarized in Table 1. See **Worksheets #15-1** through **#15-3** for a detailed list of the PALs and PILs for each constituent by medium.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

TABLE 1
 Project Indicator Levels

Parameter	PIL	Justification
AVS/SEM	Not available	The ratio of SEM to AVS will be used to evaluate the potential bioavailability of lead in sediment.
Grain size	Not available	Grain size data will be used to characterize sediment conditions in terms of habitat for certain invertebrates.
pH	6 - 8.5	A pH value ranging from 6 to 8.5 is ideal for supporting microbial populations needed for natural attenuation in groundwater. Data for pH in soil will be used to help determine lead bioavailability and leaching potential. Data for pH in sediment will be used to evaluate habitat conditions.
TOC	> 20 milligrams per liter (mg/L)	TOC is an indicator of the total amount of organic matter available to microbial communities to use as a carbon source in the degradation of organic compounds. TOC data in sediment will be used to adjust equilibrium partitioning-based ESVs and to evaluate habitat conditions. TOC data in soil will be used to help evaluate fate, transport, and bioavailability.

What will the data be used for?

- The data will be used to delineate the nature and extent of lead and PAHs in soil and sediment and to evaluate whether soil and sediment impacts pose an unacceptable risk to current or future receptors. The data will also be used to determine whether site activities have impacted site groundwater and whether groundwater impacts pose an unacceptable risk to current or future receptors. The data will be used to determine if lead is bioaccumulating in fish and/or earthworms at environmentally significant concentrations, and whether site media is directly toxic to representative ecological receptors. A baseline HHRA and a baseline ERA (which will be conducted in accordance with applicable USEPA and/or Navy guidance) will be performed to evaluate whether the site warrants no action, further investigation, a removal action, or another type of remediation. This determination will be based on the quantitative HHRA and ERA, and where applicable, background and MCL exceedances.

What types of data are needed?

The data collected will be representative of historical activities at the Skeet and Trap Range at DNA and will include:

- The Phase 1 investigation activities include the collection of soil and sediment samples. The locations of these samples were selected based on the historical SI results and the findings of the pellet/clay target survey.
- During the Phase 1 investigation, co-located surface and subsurface soil samples will be collected within the range fan area to determine the nature and extent of site contaminants. Surface soil samples will be collected at a depth of 0 to 12 inches bgs, and subsurface samples will be collected at depths of 12 to 24 inches bgs and 24 to 48 inches bgs. A pellet/clay target count will be performed at each surface soil sampling location using the same collection and processing methods employed during the initial field survey to allow a direct comparison between chemical concentrations and the quantity of pellets/clay target fragments, as well as to evaluate direct ingestion of lead shot by terrestrial avian receptors; however, the processing and counting will be done in the laboratory rather than in the field. Direct ingestion of lead shot will be evaluated using the model described in USEPA (2011). The characterization of the number of grit particles that are lead shot will use the methods described in Peddicord and LaKind (2000) and will be based on three composite site samples.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

- During the Phase 1 investigation, surface sediment samples will be collected within the range fan area to determine the nature and extent of site contaminants. Surface sediment samples will be collected at a depth of 0 to 6 inches. A pellet/clay target count will be performed at each surface sediment sampling location using the same collection and processing methods employed during the initial field survey to allow a direct comparison between chemical concentrations and the quantity of pellets/clay target fragments; however, the processing and counting will be done in the laboratory rather than in the field.
- During the Phase 1 investigation, sediment cores will be pushed by hand to a depth of 24 inches at each surface sediment sample location to characterize the lithology of the sediment (stratification, grain size) and to evaluate whether lead shot and clay target fragments are present in the subsurface sediment. If evidence of lead shot and/or clay target fragments are present in the subsurface sediment interval, a subsurface sediment sample within the 6 to 24 inch depth interval will be collected at that location for lead and/or PAHs (actual depth of the sample will depend upon where the lead pellets and/or target fragments are found within the core). The analyses for each subsurface sediment sample will be determined in the field based on the sediment core observations.
- The physical parameters to be collected for soil and sediment will be used to evaluate the fate and transport of contaminants as described in Table 1. In addition to the PILs described in Table 1, ammonia and sulfide data in Phase 2 surface sediment will be used to evaluate any anomalous results in sediment toxicity tests since they may be confounding factors in some situations.
- If soil and sediment data gaps are identified following the Phase 1 RI sampling, additional soil and/or sediment samples will be collected to fill those data gaps during a Phase 2 RI sampling event.
- If Phase 2 RI sampling is warranted for groundwater, shallow permanent groundwater monitoring wells will be installed to evaluate the nature and extent of site-related groundwater impacts. At a minimum, one of the monitoring wells will be installed upgradient of the site to evaluate the background concentrations of lead and/or PAHs that are not attributable to the Skeet and Trap Range.
- Geologic data will be collected during the monitoring well installation and sediment core collection to characterize site lithology.
- If Phase 2 RI sampling is warranted for fish tissue, both whole body and fillet fish tissue samples will be collected.
- If Phase 2 RI sampling is warranted for earthworm tissue, earthworms will be collected from the range fan area and reference (background) locations.
- If Phase 2 toxicity testing is warranted for soil, soil toxicity tests for earthworms will be performed on soil samples collected for analytical chemistry and physical parameters. Soil samples will be collected from the range fan area and reference (background) locations.
- If Phase 2 toxicity testing is warranted for sediment, sediment invertebrate tests will be performed on surface sediment samples collected for analytical (including ammonia and sulfides) and physical parameters. Sediment samples will be collected from the range fan area and reference (background) locations.

Are there any special data quality needs, field or laboratory, in order to support environmental decisions?

Field activities will be performed in accordance with the standard operating procedures (SOPs) for laboratory and sampling techniques referenced in this UFP-SAP, **Worksheets #21 and #23**.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

The off-site laboratory analytical data will be of the quantity and quality necessary to provide technically sound and defensible assessments with respect to the aforementioned project objectives. QC sample requirements are detailed in **Worksheet #20**. For action decisions, the laboratory will follow the Measurement Performance Criteria (MPC) in **Worksheet #12** for field QC samples and **Worksheets #24 and #28** for laboratory QC samples.

These MPC are consistent with the DoD Quality Systems Manual (QSM), as applicable, and laboratory in-house limits where the QSM does not apply.

In the instance that the laboratory LOD for a specific constituent is greater than the corresponding PAL, any detection of this constituent above a corresponding 95 percent background upper tolerance limit (UTL) will be considered potentially site-related. In those cases where this specific constituent is not detected above the LOD, the analyte will be considered not present.

In efforts to reach lower limits, the laboratory will report concentrations between the LOQ and DL as estimated. These results will have a J qualifier applied to them indicating that they are quantitative estimates.

Data will be validated by CH2M HILL using the procedures listed in **Worksheet #36**. A full level IV equivalent data package and QC sampling are required for these data. A Level IV equivalent data package includes a case narrative, all field sample results, QC forms, and raw data.

How much data are needed (number of samples for each analytical group, matrix, and concentration)?

The number of samples to be collected for each analytical group are provided in **Worksheet #17**. Sample locations are intended to fill data gaps in the current dataset such that the nature and extent of contamination and potential risks can be adequately assessed. Target analytical concentrations (that is, quantitation limits [QLs]) are listed in **Worksheet #15**.

Where, when, and how should the data be collected/generated?

The data will be collected and generated in accordance with the SOPs contained in this SAP. Fieldwork is tentatively scheduled to begin in May 2014. The fieldwork will be conducted in more than one mobilization as detailed in the project schedule (**Worksheet #16**). Multiple mobilizations are necessary to allow for evaluation of the Phase 1 analytical results prior to planning the Phase 2 soil, sediment, groundwater, tissue, and toxicity sampling. Validated data would be received approximately 7 weeks after the lab receives each set of samples.

How will the data be reported?

Following the completion of Phase 1 sampling and data validation, a Technical Memorandum will be prepared to summarize the Phase 1 investigation findings and the results of the human health and ecological risk screenings. The Phase 1 Technical Memorandum will be used by the Partnering Team to help determine the need for any Phase 2 sampling, and, if needed, to support development of the Phase 2 scope and sampling approach.

Once all sampling (both Phase 1 and, if warranted, Phase 2) has been completed at the site, a RI report will be prepared that presents the data and evaluation of results. In general, CERCLA guidance will be followed.

SAP Worksheet #12-1—Measurement Performance Criteria Table for Field QC Samples

Matrix: Soil and Sediment

Analytical Group: PAH

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	MPC
Field Duplicate ¹	PAH	1 per 10 field samples of similar matrix	Precision	Relative Percent Difference (RPD) ≤ 30%
Equipment Blank		1 per day of sampling for decontaminated equipment, 1 per lot for disposable equipment	Bias / Contamination	No target analytes detected > 1/2 LOQ
Cooler Temperature Indicator		1 per cooler to the laboratory	Representativeness	Temperature ≤ 6 degrees Celsius (°C), not frozen

Notes:

¹Field QA/QC will be collected separately for each matrix

SAP Worksheet #12-2—Measurement Performance Criteria Table for Field QC Samples

Matrix: Soil and Sediment

Analytical Group: METALS (Pb only)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC
Field Duplicate ¹	METALS (Pb only)	1 per 10 field samples of similar matrix	Precision	RPD \leq 30%
Equipment Blank		1 per day of sampling for decontaminated equipment, 1 per lot for disposable equipment	Bias / Contamination	No target analytes detected > 1/2 LOQ
Cooler Temperature Indicator		1 per cooler to the laboratory	Representativeness	Temperature \leq 6 °C, not frozen

Notes:

¹Field QA/QC will be collected separately for each matrix

SAP Worksheet #12-3—Measurement Performance Criteria Table for Field QC Samples

Matrix: Soil and Sediment

Analytical Group: Wet Chemistry (pH, TOC, and AVS/SEM [sediment only])

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC
Field Duplicate ¹	Wet Chemistry (pH, TOC, and AVS/SEM)	1 per 10 field samples of similar matrix	Precision	RPD ≤ 30%
Cooler Temperature Indicator		1 per cooler to the laboratory	Representativeness	Temperature ≤ 6 °C, not frozen

Notes:

¹Field QA/QC will be collected separately for each matrix

SAP Worksheet #12-4—Measurement Performance Criteria Table for Field QC Samples

Matrix: Groundwater

Analytical Group: PAH

Concentration Level: Medium / Low

QC Sample	Analytical Group	Frequency	DQIs	MPC
Field Duplicate ¹	PAH	1 per 10 field samples of similar matrix	Precision	RPD ≤ 20%
Equipment Blank		1 per day of sampling for decontaminated equipment, 1 per lot for disposable equipment	Bias / Contamination	No target analytes detected > 1/2 LOQ
Cooler Temperature Indicator		1 per cooler to the laboratory	Representativeness	Temperature ≤ 6 °C, not frozen

Notes:

¹Field QA/QC will be collected separately for each matrix

SAP Worksheet #12-5—Measurement Performance Criteria Table for Field QC Samples

Matrix: Groundwater

Analytical Group: Total and Dissolved Metals (Pb only)

Concentration Level: Medium / Low

QC Sample	Analytical Group	Frequency	DQIs	MPC
Field Duplicate ¹	Metals (Pb only)	1 per 10 field samples of similar matrix	Precision	RPD \leq 20%
Equipment Blank		1 per day of sampling for decontaminated equipment, 1 per lot for disposable equipment	Bias / Contamination	No target analytes detected > 1/2 LOQ
Cooler Temperature Indicator		1 per cooler to the laboratory	Representativeness	Temperature \leq 6 °C, not frozen

Notes:

¹Field QA/QC will be collected separately for each matrix

SAP Worksheet #12-6—Measurement Performance Criteria Table for Field QC Samples

Matrix: Tissue

Analytical Group: Metals (Pb only), % Moisture, and % Lipids

Concentration Level: Medium / Low

QC Sample	Analytical Group ²	Frequency	DQIs	MPC
Field Duplicate ¹	Metals (Pb only), %Moisture, and %Lipids	1 per 10 field samples of similar matrix	Precision	RPD \leq 30%
Cooler Temperature Indicator		1 per cooler to the laboratory	Representativeness	Temperature \leq 6 °C, not frozen

Notes:

¹Field QA/QC will be collected separately for each matrix

²Field QA/QC as described in this table will be collected and analyzed for each of the analytical group listed

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

[\(UFP-QAPP Manual Section 2.7\)](#)

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Skeet Range Historical Data	Malcolm Pirnie. 2008. Final Preliminary Assessment, Naval Air Station Oceana, Dam Neck Annex, and Naval Auxiliary Landing Field Fentress, Virginia Beach, Virginia. October.	Malcolm Pirnie	Data will be used to understand the site history, geology, and hydrogeology.	None known
Skeet Range Historical Data	CH2M HILL. 2012. Final Site Inspection of the Former Small Arms Firing Ranges, Naval Air Station Oceana, Fleet Combat Training Center-Dam Neck Annex, Naval Auxiliary Landing Field-Fentress, Virginia Beach, Virginia. January.	CH2M HILL	Data will be used to determine the COCs and potential human health and ecological risk. Additionally these data were used to propose sample locations for the RI.	None known

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SAP Worksheet #14—Summary of Project Tasks

[\(UFP-QAPP Manual Section 2.8.1\)](#)

Project Logistics

In general, work will be performed in Level D personal protective equipment (PPE), which includes hardhat, safety glasses, safety toed boots, and hearing protection. Optional PPE includes the use of Tyvek coveralls as necessary. A personal flotation device (PFD) should be used when working within 6 feet from water and when working on the boat. Upgrades to higher levels of PPE are discussed in the Health and Safety Plan (HSP), which will be provided as a separate document from this UFP-SAP.

Field investigation activities will be performed over separate mobilizations, as follows:

- Mobilization #1: Phase 1 soil and sediment sampling; pellet/clay target counts
- Mobilization #2: Phase 2 soil and sediment sampling (toxicity testing); pellet/clay target counts; tissue sampling; installation and sampling of permanent groundwater monitoring wells (if needed)

Well installation, development, and sampling will take place during normal working hours. Following the investigational activities, the site will be restored to its original condition.

Coordinate sediment sampling activities, including Right of Entry Permit, with HRSD.

Project Tasks

- Applicable SOPs for project tasks outlined in this section are listed on **Worksheet #21** and provided in **Appendix A**.

Utility Clearance

Utilities will be cleared before beginning intrusive activities. CH2M HILL will coordinate utility clearance with Miss Utility of Virginia and the base's approving authority. Additionally, a separate utilities subcontractor will be procured to ensure the accuracy of the utility markings. Any proposed soil sampling and monitoring well locations interfering with utility locations will be relocated to avoid impact to utilities while continuing to meet the intent of the sampling rationale.

Investigational Activities

Phase One Surface and Subsurface Soil Sampling—Surface and subsurface soil samples will be collected using a hand auger at approximately 27 locations in the vicinity of the Skeet and Trap Range at DNA (**Figures 9 and 10**). Surface soil samples will be collected from 0 to 12 inches bgs and subsurface soil samples will be collected from 12 to 24 inches bgs and 24-48 inches bgs. Surface soil and subsurface soil (12-24 inches bgs) samples will be analyzed for lead and pH and/or PAHs and TOC. The 24-48 inch bgs subsurface soil sample at each location will be analyzed for lead and pH and/or PAHs. A pellet/clay target count will be performed at each Phase 1 surface soil sampling location using the same collection and processing methods employed during the initial field survey; however, the processing and counting will be done in the laboratory rather than in the field.

Phase One Sediment Sampling—Sediment cores (0 to 24 inches below sediment surface [bss]) will be collected by hand-pushing a piece of Lexane tubing at approximately 21 locations within Lake Tecumseh. A slide hammer may be used if the core cannot be pushed by hand. Sediment cores will be logged, characterized, and visually inspected for lead shot/clay target fragments. Surface sediment (0 to 6 inches bss) will be analyzed for lead and/or PAHs, plus pH, TOC, AVS/SEM, and grain size. Subsurface sediment (depth based on visual inspection results) samples may also be collected and analyzed for lead and/or PAHs if the sediment core indicates the potential for contamination. A pellet/clay target count will be performed at each Phase 1 surface sediment sampling location using the same collection and processing methods employed during the initial field survey; however, the processing and counting will be done in the laboratory rather than in the field.

SAP Worksheet #14—Summary of Project Tasks (continued)

Surface water quality parameters (pH, specific conductance, turbidity, dissolved oxygen [DO], temperature, salinity, and oxidation-reduction potential [ORP]) will be collected using a Horiba U-22 or equivalent water quality meter at each sediment location. Measurements will be taken at the top, middle, and bottom of the water column. Water depth will also be measured.

Phase Two Soil and Sediment Sampling/Toxicity Testing— Surface soil samples (0 to 12 inches bgs) will be collected at up to 12 site locations and 3 reference locations and analyzed for lead, PAHs, pH, and TOC. If Phase 2 toxicity testing is warranted for soil, soil toxicity tests for earthworms (*Eisenia fetida*) will be performed on soil samples collected for analytical chemistry and physical parameters. Endpoints for the soil toxicity tests are survival, growth, and reproduction. A pellet/clay target count will be performed at each Phase 2 soil sampling location using the same collection and processing methods employed during the initial field survey and Phase 1 sampling event to allow a direct comparison between chemical concentrations, toxicity test results, and the quantity of pellets/clay target fragments; however, the processing and counting will be done in the laboratory.

Surface sediment (0 to 6 inches bss) will be collected at up to 9 site locations and 3 reference locations and analyzed for lead, PAHs, ammonia, sulfides, pH, TOC, AVS/SEM, and grain size. If Phase 2 toxicity testing is warranted for sediment, sediment invertebrate tests (using *Hyalella azteca*) will be performed on surface sediment samples collected for analytical chemistry and physical parameters. Endpoints for the sediment toxicity tests are survival and growth. A pellet/clay target count will be performed at each Phase 2 sediment sampling location using the same collection and processing methods employed during the initial field survey and Phase 1 sampling event; however, the processing and counting will be done in the laboratory.

Surface water quality parameters (pH, specific conductance, turbidity, DO, temperature, salinity, and ORP) will be collected using a Horiba U-22 or equivalent water quality meter at each sediment location. Measurements will be taken at the top, middle, and bottom of the water column. Water depth will also be measured.

Phase Two Tissue Sampling— Earthworms may be field collected from up to 12 site locations and 3 reference locations and analyzed for lead, percent moisture, and percent lipids; these samples will be collected at each toxicity testing location to allow for a correlation of bioaccumulation and toxicity to be conducted. The resulting concentrations will be used in ecological food web models to determine if the concentrations pose a potential risk to upper trophic level receptors that may consume them. The number of proposed earthworm toxicity testing and tissue samples was based on professional judgment when considering the analytical results from the existing surface soil samples (magnitude and spatial distribution of lead, including lead shot), but may change based on the results of the Phase 1 sampling activities. Additionally, up to 15 fish tissue samples may be collected and analyzed for lead, percent moisture, and percent lipids. The species selected will be determined following a reconnaissance survey to determine the species and size classes of fish that are present. Both whole body (in the size range consumed by piscivorous wildlife) and fillet (edible sized fish for human consumption) samples may be collected. Fish samples will be collected in groups of 5 samples (3 such groups are proposed, but this may change based on the results of the Phase 1 sampling activities) to provide sufficient samples for statistical analysis within each group. In addition to fillet/whole body, groups may also be based on other factors such as trophic level (e.g., bottom feeders and water column predators).

Phase Two Monitoring Well Installations—Groundwater investigation activities may be performed if warranted by the Phase 1 results. Approximately six shallow permanent, 2-inch diameter groundwater monitoring wells may be installed in the vicinity of the skeet and trap range. Monitoring wells will be installed to an approximate depth of 20 feet using direct-push-technology (DPT) drilling methods. During installation of the 6 permanent wells, continuous core logs will be collected. New monitoring well screen intervals will be determined through the use of historical site information and observed field conditions. Each new monitoring well will be constructed with 2-inch inside-diameter Schedule 40 polyvinyl chloride (PVC) screen and riser. The monitoring well screen will be

SAP Worksheet #14—Summary of Project Tasks (continued)

machine-slotted, 0.010 inch, and 10 feet long. A silica filter pack will be placed around the annular space of the well screen from the bottom of the boring extending to 2 feet above the top of the screen. A 2-foot-thick bentonite layer will be placed above the sand pack. After the bentonite has been hydrated, a cement-bentonite grout will be placed in the remaining annular space. The monitoring wells will be completed with stickup casing with a watertight steel cover. A locking watertight cap will be placed on the PVC pipe and the wells clearly marked. Wells will be surrounded with bollards and locked.

- **Phase Two Monitoring Well Development**--Each new monitoring well will be developed using a submersible pump. Well development will be performed in accordance with SOPs in **Appendix A**. Development information, including readings of turbidity, pH, specific conductivity, temperature, and gallons removed, will be recorded in the field logbook.
- **Phase Two Water-Level Survey**--A complete round of water levels will be recorded from the monitoring wells. Depth to water and time measured will be recorded in the field logbook.

Phase Two Monitoring Well Groundwater Sampling—Permanent groundwater monitoring wells will be purged using a peristaltic pump following low-flow sampling protocol prior to sampling. Groundwater quality parameters (pH, specific conductance, turbidity, DO, temperature, salinity, and ORP) will be collected using a Horiba U-22 or equivalent water quality meter, recorded, and allowed to stabilize before a sample is collected. The permanent groundwater monitoring wells will be sampled using a peristaltic pump for PAHs and/or total and dissolved lead. The analytes for site groundwater will be determined based on the Phase 1 analytical results.

Equipment Decontamination

- All non-disposable sampling equipment will be decontaminated before use and immediately after each use in accordance with applicable SOPs (**Appendix A**). The water-level indicator will be rinsed with deionized water between each measurement. Heavy equipment such as drill rig (augers, rods or split spoons) will be steam-cleaned before use at each new monitoring well location. Monitoring well risers and screens will also be steam-cleaned using the same procedure, unless they are certified by the manufacturer as clean and the plastic seals are intact. A decontamination pad will be set up to prevent runoff of the decontamination water and to allow easy collection of decontamination fluids.

Quality Control

- Implement SOPs for field activities (Appendix A) being performed.
- Summary of daily field activities will be documented in a field log book; this log book will also detail sampling activities and information regarding soil sampling, sediment sampling, fish and earthworm/invertebrate sampling, boring logs, well construction, well development and groundwater sampling.
- QC samples to be collected are outlined on **Worksheet #20**.

Surveying

- Groundwater monitoring well locations will be horizontally located (± 0.1 feet) and monitoring well elevations (top of casing and ground surface) will be vertically located (± 0.01 feet) by a Virginia-licensed surveyor.

Analytical Tasks

- The laboratory will maintain, test, inspect, and calibrate analytical instruments (**Worksheets #24 and #25**).
- The laboratory will process and prepare samples for analysis.

SAP Worksheet #14—Summary of Project Tasks (continued)

Data Management

- Procedures for data tracking, storage, archiving, retrieval and security for both electronic and hardcopy data:
 - The PC is responsible for data tracking and storage
 - The data management subcontractor will coordinate archiving and retrieval of data

Project Assessment/Audit

- **Worksheets #31 and #32**

Data Review

- Data Validation (**Worksheets #35 and #36**)

SAP Worksheet #15-1a—Reference Limits and Evaluation Table

Matrix: Surface Soil and Subsurface Soil

Analytical Group: PAH

Analyte	Chemical Abstract Services (CAS) Number	ESV for Soil ⁴ (micrograms per kilogram [µg/kg])	RSL Residential Soil, May 2013 ¹ (µg/kg)	Project Quantitation Limit (PQL) Goal ² (µg/kg)	Laboratory-Specific (µg/kg)			Laboratory Control Sample (LCS), Matrix Spike (MS), and Matrix Spike Duplicate (MSD) Percent Recovery (%R) Limits ³		
					LOQ	LOD	DL	Lower Control Limit (LCL)	Upper Control Limit (UCL)	%RPD
2-Methylnaphthalene	91-57-6	3625	23000	1812.5	20	10	2.2	10	152	30
Acenaphthene	83-32-9	3625	340000	1812.5	20	10	1.5	33	98	
Acenaphthylene	208-96-8	3625	340000	1812.5	20	10	1.2	25	94	
Anthracene	120-12-7	3625	1700000	1812.5	20	10	1.2	34	96	
Benzo(a)anthracene	56-55-3	2000	150	75	20	10	1.9	48	100	
Benzo(a)pyrene	50-32-8	2000	15	7.5	20	10	3.3	61	101	
Benzo(b)fluoranthene	205-99-2	2000	150	75	20	10	2.4	53	100	
Benzo(g,h,i)perylene	191-24-2	2000	170000	1000	20	10	2	53	103	
Benzo(k)fluoranthene	207-08-9	2000	1500	750	20	10	3.1	49	96	
Chrysene	218-01-9	2000	15000	1000	20	10	1.7	46	101	
Dibenz(a,h)anthracene	53-70-3	2000	15	7.5	20	10	1.8	55	105	
Fluoranthene	206-44-0	3625	230000	1812.5	20	10	1.8	38	116	
Fluorene	86-73-7	3625	230000	1812	20	10	3.2	40	92	
Indeno(1,2,3-cd)pyrene	193-39-5	2000	150	75	20	10	1.9	50	105	
Naphthalene	91-20-3	3625	3600	1800	20	10	2.6	10	129	
Phenanthrene	85-01-8	3625	1700000	1812.5	20	10	1.8	46	96	
Pyrene	129-00-0	2000	170000	1000	20	10	2.1	35	111	

Notes

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet #11** for a detailed discussion on development of PALs.

² PQL Goals are equal to half of the minimum of the applicable criteria (PALs).

³ DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. **Bolded** values represent in-house limits when DoD QSM v.4.2 limits do not exist.

⁴ ESVs apply only to 0-24 inch samples. These PALs are the ESV (29,000 µg/kg and 18,000 µg/kg for LMW and HMW PAHs, respectively) divided by the number of compounds in each group.

SAP Worksheet #15-1b—Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: PAH

Analyte	CAS Number	ESV for Freshwater Sediment (µg/kg)	RSL Res Soil x10 for Sediment, May 2013 ¹ (µg/kg)	PQL Goal ² (µg/kg)	Laboratory-Specific (µg/kg)			LCS, MS, and MSD %R Limits ³		
					LOQ	LOD	DL	LCL	UCL	%RPD
2-Methylnaphthalene	91-57-6	20.2	230000	10.1	20	10	2.2	10	152	30
Acenaphthene	83-32-9	290	3400000	145	20	10	1.5	33	98	
Acenaphthylene	208-96-8	160	3400000	80	20	10	1.2	25	94	
Anthracene	120-12-7	57.2	17000000	28.6	20	10	1.2	34	96	
Benzo(a)anthracene	56-55-3	108	1500	54	20	10	1.9	48	100	
Benzo(a)pyrene	50-32-8	150	150	75	20	10	3.3	61	101	
Benzo(b)fluoranthene	205-99-2	240	1500	120	20	10	2.4	53	100	
Benzo(g,h,i)perylene	191-24-2	170	15000	85	20	10	2	53	103	
Benzo(k)fluoranthene	207-08-9	240	1700000	120	20	10	3.1	49	96	
Chrysene	218-01-9	166	150000	83	20	10	1.7	46	101	
Dibenz(a,h)anthracene	53-70-3	33.0	150	16.5	20	10	1.8	55	105	
Fluoranthene	206-44-0	423	2300000	211.5	20	10	1.8	38	116	
Fluorene	86-73-7	77.4	2300000	38.7	20	10	3.2	40	92	
Indeno(1,2,3-cd)pyrene	193-39-5	200	1500	100	20	10	1.9	50	105	
Naphthalene	91-20-3	176	36000	88	20	10	2.6	10	129	
Phenanthrene	85-01-8	204	17000000	102	20	10	1.8	46	96	
Pyrene	129-00-0	195	1700000	97.5	20	10	2.1	35	111	

Notes

¹ PALs were developed to be protective of human health and the environment. Refer to Worksheet #11 for a detailed discussion on development of PALs.

² PQL Goals are equal to half of the minimum of the applicable criteria (PALs).

³ DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.2 limits do not exist.

SAP Worksheet #15-1c—Reference Limits and Evaluation Table

Matrix: Surface and Subsurface Soil

Analytical Group: METAL

Analyte	CAS Number	ESV for Soil ⁴ (mg/kg)	RSL Residential Soil, May 2013 ¹ (mg/kg)	PQL Goal ² (mg/kg)	Laboratory-Specific (mg/kg)			LCS, MS, and MSD %R Limits ³		
					LOQ	LOD	DL	LCL	UCL	%RPD
Lead	7439-92-1	120	400	60	0.5	0.4	0.09	80	120	20

Notes

¹ PALs were developed to be protective of human health and the environment. Refer to Worksheet #11 for a detailed discussion on development of PALs.

² PQL Goals are equal to half of the minimum of the applicable criteria (PALs).

³ DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. **Bolded** values represent in-house limits when DoD QSM v.4.2 limits do not exist.

⁴ ESV only applies to samples from 0-24 inches.

SAP Worksheet #15-1d—Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: METAL

Analyte	CAS Number	ESV for Freshwater Sediment (mg/kg)	RSL Residential Soil, May 2013 ¹ (mg/kg)	PQL Goal ² (mg/kg)	Laboratory-Specific (mg/kg)			LCS, MS, and MSD %R Limits ³		
					LOQ	LOD	DL	LCL	UCL	%RPD
Lead	7439-92-1	35.8	400	17.9	0.5	0.4	0.09	80	120	20

Notes

¹ PALs were developed to be protective of human health and the environment. Refer to Worksheet #11 for a detailed discussion on development of PALs.

² PQL Goals are equal to half of the minimum of the applicable criteria (PALs).

³ DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. **Bolded** values represent in-house limits when DoD QSM v.4.2 limits do not exist.

SAP Worksheet #15-1e—Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: AVS/SEM

Analyte ¹	CAS Number ²	Laboratory-Specific (micromoles per gram [μmol/g])			LCS, MS, and MSD %R Limits ³		
		LOQ	LOD	DL	LCL	UCL	%RPD
AVS	ACIDSO2	0.10	0.076	0.038	80	120	20
Cadmium	7440-43-9	0.00089	0.00053	0.000014			
Copper	7440-50-8	0.007868	0.003147	0.00073			
Lead	7439-92-1	0.000483	0.000386	0.00015			
Mercury	7439-97-6	0.000020	0.000018	0.000016			
Nickel	7440-02-0	0.00341	0.001363	0.00022			
Zinc	7440-66-6	0.00612	0.00306	0.0011			
Silver	7440-22-4	0.00185	0.000742	0.00010			

Notes

¹The ratio of AVS/SEM will be used to evaluate the potential bioavailability of lead in sediment

²In some instances a contractor-specific identifier is used instead of a CAS Number

³ DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.2 limits do not exist.

SAP Worksheet #15-1f—Reference Limits and Evaluation Table

Matrix: Soil (SS, SB) and Sediment

Analytical Group: Wet Chemistry (Ammonia [sediment only], sulfides [sediment only], pH, and TOC)

Analyte	CAS Number	PIL ¹	Units	Laboratory-Specific			LCS, MS, and MSD %R Limits ²		
				LOQ	LOD	DL	LCL	UCL	%RPD
Ammonia	7664-41-7	NC	mg/kg	5.0	2.5	0.26	80	120	20
Sulfide	18496-25-8	NC	mg/kg	60	60	60	50	150	50
TOC	TOC	NC	mg/kg	400	300	87.8	80	120	30 ³
pH	PH	5 < pH > 8	pH	NC	NC	NC	NC	NC	NC

Notes

¹ PALs were developed to be protective of human health and the environment. Refer to Worksheet #11 for a detailed discussion on development of PALs.

² DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.2 limits do not exist.

³ Sample Quadruplicate

NC indicates that there is no criterion for a particular analyte.

SAP Worksheet #15-1g—Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: Grain-size

Analyte ^{1,2}	CAS Number ³	Units
GS03 Sieve 3" (75 millimeters [mm])	SIEVE75.0	% Passing
GS05 Sieve 2" (50 mm)	SIEVE50.0	% Passing
GS06 Sieve 1.5" (37.5 mm)	SIEVE37.5	% Passing
GS07 Sieve 1" (25.0 mm)	SIEVE25.0	% Passing
GS08 Sieve 0.75" (19.0 mm)	SIEVE19.0	% Passing
GS10 Sieve 0.375" (9.5 mm)	SIEVE9.5	% Passing
Sieve No. 004 (4.75 mm)	SIEVE4.75	% Passing
Sieve No. 010 (2.00 mm)	SIEVE2.0	% Passing
Sieve No. 020 (850 micrometers [μm])	SIEVE850	% Passing
Sieve No. 040 (425 μm)	SIEVE425	% Passing
Sieve No. 060 (250 μm)	SIEVE250	% Passing
Sieve No. 080 (180 μm)	SIEVE180	% Passing
Sieve No. 100 (150 μm)	SIEVE150	% Passing
Sieve No. 200 (75 μm)	SIEVE75	% Passing

Notes

¹There are no action limits, laboratory reporting limits, or LCS recovery limits for grain-size analytes.

² Grain-size data will be used to characterize sediment conditions in terms of habitat for certain invertebrates.

³ In some instances a contractor-specific identifier is used.

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SAP Worksheet #15-2a—Reference Limits and Evaluation Table

Matrix: Groundwater
 Analytical Group: PAH

Analyte	CAS Number	PALs ¹		PQL Goal ² (µg/L)	Laboratory-Specific (µg/L)			LCS, MS, and MSD %R Limits ³		
		MCL (µg/L)	RSLs Tapwater, May 2013 (micrograms per liter [µg/L])		LOQ	LOD	DL	LCL	UCL	%RPD
2-Methylnaphthalene	91-57-6	NC	2.7	1.35	0.2	0.1	0.077	51	110	30
Acenaphthene	83-32-9	NC	40	20	0.2	0.1	0.064	53	90	
Acenaphthylene	208-96-8	NC	40	20	0.2	0.1	0.054	55	105	
Anthracene	120-12-7	NC	130	65	0.2	0.1	0.044	70	95	
Benzo(a)anthracene	56-55-3	NC	0.029	0.0145	0.2	0.1	0.046	10	110	
Benzo(a)pyrene	50-32-8	0.2	0.0029	0.00145	0.2	0.1	0.066	63	96	
Benzo(b)fluoranthene	205-99-2	NC	0.029	0.0145	0.2	0.1	0.089	67	102	
Benzo(g,h,i)perylene	191-24-2	NC	8.7	4.35	0.2	0.1	0.065	42	106	
Benzo(k)fluoranthene	207-08-9	NC	0.29	0.145	0.2	0.1	0.049	68	103	
Chrysene	218-01-9	NC	2.9	1.45	0.2	0.1	0.036	70	95	
Dibenz(a,h)anthracene	53-70-3	NC	0.0029	0.00145	0.2	0.1	0.07	66	106	
Fluoranthene	206-44-0	NC	63	31.5	0.2	0.1	0.073	81	109	
Fluorene	86-73-7	NC	22	11	0.2	0.1	0.061	53	95	
Indeno(1,2,3-cd)pyrene	193-39-5	NC	0.029	0.0145	0.2	0.1	0.052	61	112	
Naphthalene	91-20-3	NC	0.14	0.07	0.2	0.1	0.064	46	84	
Phenanthrene	85-01-8	NC	130	65	0.2	0.1	0.051	73	100	
Pyrene	129-00-0	NC	8.7	4.35	0.2	0.1	0.059	71	104	

Notes

¹ PALs were developed to be protective of human health and the environment. Refer to Worksheet #11 for a detailed discussion on development of PALs. The MCL will be used as the PAL if it is lower than the RSL. The lower of the RSL and MCL will be used as the PAL.

² PQL Goals are equal to half the minimum of the applicable criteria (PALs).

³ DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.2 limits do not exist.

Shading represents cases where the PAL or PQL goal is less than the laboratory LOD. Non-detected analytes are reported at the LOD. Non-detects will not be treated as exceedances, though they may be reported at a value greater than the PAL.

NC indicates that there is no criterion for a particular analyte.

SAP Worksheet #15-2b—Reference Limits and Evaluation Table

Matrix: Groundwater

Analytical Group: Total and Dissolved Metals

		PALs ¹								
Analyte	CAS Number	MCL (µg/L)	RSLs Tapwater, May 2013 (µg/L)	PQL Goal ² (µg/L)	Laboratory-Specific (µg/L)			LCS, MS, and MSD %R Limits ³		
					LOQ	LOD	DL	LCL	UCL	%RPD
Lead	7439-92-1	15	15	7.5	5	4	1.1	80	120	20

Notes

¹ PALs were developed to be protective of human health and the environment. Refer to Worksheet #11 for a detailed discussion on development of PALs. The MCL will be used as the PAL if it is lower than the RSL. The lower of the RSL and MCL will be used as the PAL.

² PQL Goals are equal to half the minimum of the applicable criteria (PALs).

³ DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.2 limits do not exist.

SAP Worksheet #15-3—Reference Limits and Evaluation Table

Matrix: Tissue

Analytical Group: Metals and Wet Chemistry

Analyte	CAS Number	HHRA PAL ¹	Eco PAL ²	PQL Goal	Units	Laboratory-Specific (mg/kg)			LCS, MS, and MSD %R Limits		
						LOQ	LOD	DL	LCL	UCL	%RPD
Lead	7439-92-1	0.35	2.50	0.175	mg/kg	0.5	0.4	0.09	80	120	20
% Moisture	%MOIST	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Lipids (%)	LIPIDS	NC	NC	NC	NC	0.1	NC	0.05	NC	NC	NC

Notes

¹ The lead fish tissue concentration value is derived by using IEUBK model and default concentrations for all other media except dietary (and assumed all dietary lead from fish).

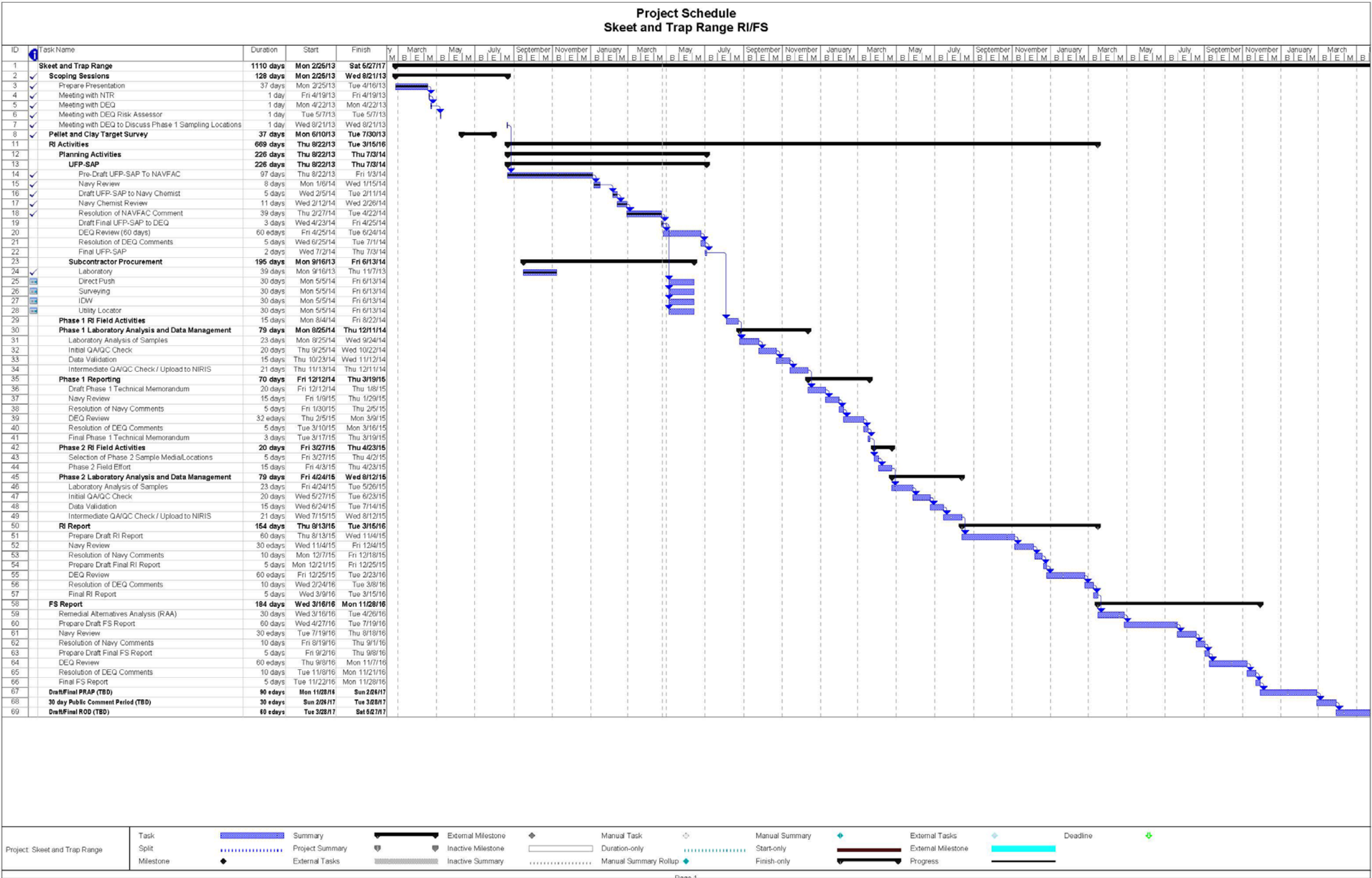
² Eco PAL is based on literature-based tissue ESV (wet-weight).

NC indicates that there is no criterion for a particular analyte.

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SAP Worksheet #16—Project Schedule/Timeline Table

(UFP-QAPP Manual Section 2.8.2)



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SAP Worksheet #17—Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

Matrix	Depths to Sample	Analysis	Method	Number of Samples	Rationale	* Sampling Strategy
Phase 1 Surface Soil Samples	0 to 12 inches bgs (surface)	pH	SW-846 9045C/ 9045D	Approximately 27	Sampling locations were selected to fill data gaps and evaluate the distribution of lead and PAH contamination in surface soil. The observed contaminant distribution within the range fan area varies, with lead observed throughout the range fan and PAHs located closer to the historical firing line. Soil sample locations were selected throughout the range fan extent to further delineate the nature and extent of lead and PAH contamination on site.	Phase 1 surface soil sample locations were selected to fill data gaps and further delineate lead and PAHs in soil. The results of the lead pellet/clay target survey and the Expanded SI data were used to identify data gaps and areas of potentially elevated contaminant concentrations for additional delineation. Three of the soil sample locations will be analyzed for PAHs, TOC, and a pellet/clay target count to evaluate the area of the range fan potentially impacted by clay target fragments. Nine of the soil sample locations will be analyzed for PAHs, lead, TOC, pH, and a pellet/clay target count to evaluate the area of the range fan potentially impacted by lead shot and clay target fragments. Fifteen of the soil sample locations will be analyzed for lead, pH, and a pellet/clay target count to evaluate the area of the range fan potentially impacted by lead shot. See Figures 9 and 10 for proposed Phase 1 sample locations.
		TOC	Lloyd Kahn			
		Lead	SW-846 3050B, 6010C			
		PAHs	SW-846 8270D SIM			
		Pellet/clay target count	Lab method- (described in SOW)			
		Grit Characterization	Lab method- (described in SOW)	Approximately 3	During the Phase 1 sampling effort, composite soil samples will be collected to evaluate the potential for direct ingestion of lead shot using the model described in Assessment of Methods for Estimating Risks to Birds from Ingestion of Contaminated Grit Particles (USEPA, 2011). The characterization of the number of grit particles that are lead shot will use the methods described in Ecological and Human Health Risks at an Outdoor Firing Range (Peddicord and LaKind, 2000).	The grit characterization will be performed on three composite site samples sample to evaluate risk to ecological receptors through direct ingestion of lead shot.
Phase 1 Subsurface Soil Samples	12 to 24 inches bgs (subsurface)	pH	SW-846 9045C/ 9045D	Approximately 27	Sampling locations were selected to fill data gaps and evaluate the distribution of lead and PAHs in subsurface soil.	Subsurface soil sample locations were co-located with the surface soil samples to evaluate the potential for leaching of site contaminants to subsurface soil. Three of the soil sample locations will be analyzed for PAHs and TOC to evaluate the area of the range fan potentially impacted by clay target fragments. Nine of the soil sample locations will be analyzed for PAHs, lead, TOC, and pH to evaluate the area of the range fan potentially impacted by lead shot and clay target fragments. Fifteen of the soil sample locations will be analyzed for lead and pH to evaluate the area of the range fan potentially impacted by lead shot. See Figures 9 and 10 for proposed Phase 1 sample locations.
		TOC	Lloyd Kahn			
		Lead	SW-846 3050B, 6010C			
		PAHs	SW-846 8270D SIM			
	24 to 48 inches bgs (subsurface)	Lead	SW-846 3050B, 6010C	Approximately 27	Sampling locations were selected to fill data gaps and evaluate the distribution of lead and PAHs in subsurface soil.	Subsurface soil sample locations were co-located with the surface soil samples to evaluate the potential for leaching of site contaminants to subsurface soil. Three of the soil sample locations will be analyzed for PAHs to evaluate the area of the range fan potentially impacted by clay target fragments. Nine of the soil sample locations will be analyzed for PAHs, lead, and pH to evaluate the area of the range fan potentially impacted by lead shot and clay target fragments. Fifteen of the soil sample locations will be analyzed for lead and pH to evaluate the area of the range fan potentially impacted by lead shot. See Figures 9 and 10 for proposed Phase 1 sample locations.
		pH	SW-846 9045C/ 9045D			
		PAHs	SW-846 8270D SIM			

SAP Worksheet #17—Sampling Design and Rationale (continued)

Matrix	Depths to Sample	Analysis	Method	Number of Samples	Rationale	* Sampling Strategy
Phase 1 Surface and Subsurface Sediment Samples	0 to 6 inches bss (surface)	pH	SW-846 9045C/ 9045D	Approximately 21	Sampling locations were selected to fill data gaps and evaluate the distribution of lead and PAH contamination in surface sediment. The observed contaminant distribution within the range fan area varies, with lead observed throughout the range fan and PAHs located closer to the historical firing line. Surface sediment sample locations were selected throughout the range fan extent to further delineate the nature and extent of lead and PAH contamination on site. Twenty-four inch soil cores will be pushed at each of the surface sediment sample locations. If the presence of lead shot or clay target fragments are identified within the subsurface sediment cores, subsurface sediment will be sampled at those locations.	Phase 1 surface sediment sample locations were selected to fill data gaps and further delineate lead and PAHs in sediment. The results of the lead pellet/clay target survey and the Expanded SI data were used to identify data gaps and areas of potentially elevated contaminant concentrations for additional delineation. Seven of the surface sediment sample locations will be analyzed for PAHs, lead, TOC, pH, AVS/SEM, grain size and a pellet/clay target count to evaluate the area of the range fan potentially impacted by lead shot and clay target fragments. Fourteen of the surface sediment sample locations will be analyzed for lead, pH, AVS/SEM, grain size and a pellet/clay target count to evaluate the area of the range fan potentially impacted by lead shot. See Figures 9 and 10 for proposed Phase 1 sample locations.
		TOC	Lloyd Kahn			
		AVS/SEM	EPA 821-R-91-100			
		Lead	SW-846 3050B, 6010C			
		PAHs	SW-846 8270D SIM			
		Grain size	American Society for Testing and Materials (ASTM) D422			
		Pellet/clay target count	Lab method- (described in SOW)			
	6 to 24 inches bss (subsurface)	pH	SW-846 9045C/ 9045D	Approximately 21 samples may also be collected and analyzed for lead and/or PAHs if the sediment core indicates the potential for contamination		
		TOC	Lloyd Kahn			
		AVS/SEM	EPA 821_R-91-100			
		Lead	SW-846 3050B, 6010C			
		PAHs	SW-846 8270D SIM			
		Grain size	ASTM D422			
Pellet/clay target count		Lab method- (described in SOW)				
Phase 2 Surface Soil and Toxicity Testing (earthworms)	0 to 12 inches bgs	pH	SW-846 9045C/ 9045D	Up to 15	Samples for earthworm toxicity testing (endpoints are survival, growth, and reproduction) and lead and/or PAH and physical parameters may be collected in the portions of the site where contaminant concentrations in soil may be adversely impacting ecological receptors.	If warranted, the earthworm toxicity testing samples will be collected at up to 15 locations. Up to 12 of those locations will be within the range fan, and the remaining three samples may be collected as reference samples.
		TOC	Lloyd Kahn			
		Lead	SW-846 3050B, 6010C			
		PAHs	SW-846 8270D SIM			
		Pellet/clay target count	Lab method- (described in SOW)			
		Toxicity Testing (<i>Eisenia fetida</i>)	ASTM E1676			
Phase 2 Surface Sediment and Toxicity Testing (invertebrates)	0 to 6 inches bgs	Lead	SW-846 3050B, 6010C	Up to 12	Samples for invertebrate toxicity testing (endpoints are survival and growth) and lead and/or PAH and physical parameters may be collected in the portions of the site where contaminant concentrations in sediment may be adversely impacting ecological receptors.	If warranted, the invertebrate toxicity testing samples will be collected at up to 12 locations. Up to 9 of those locations will be within the range fan, and the remaining three samples may be collected as reference samples.
		PAHs	SW-846 8270D SIM			
		Ammonia	SM- 4500NH3 G			
		Sulfide	EPA 376.1/SW-846 9030/SM 4500-S2-F			
		pH	SW-846 9045C/ 9045D			
		TOC	Lloyd Kahn			
		AVS/SEM	EPA 821_R-91-100			
		Grain size	ASTM D422			
		Pellet/clay target count	Lab method- (described in SOW)			
		Toxicity Testing (<i>Hyalella azteca</i>)	EPA 600-R-99-064			

SAP Worksheet #17—Sampling Design and Rationale (continued)

Matrix	Depths to Sample	Analysis	Method	Number of Samples	Rationale	* Sampling Strategy
Fish Tissue Sampling	N/A	Lead	SW-846 3050B, 6010C	Up to 15	Fish tissue samples may be collected for lead, percent moisture, and percent lipids if Phase 1 results indicate that contaminant concentrations in sediment may be adversely impacting the fish population.	If warranted, up to 15 fish tissue samples may be collected and analyzed for the presence of lead.
		Percent Moisture	ASTM D2216			
		Percent Lipids	SW-846 8290			
Earthworm Tissue Sampling	N/A	Lead	SW-846 6010C	Up to 15	Earthworm tissue samples may be collected in the portions of the site where contaminant concentrations may be adversely impacting ecological receptors.	If earthworm tissue sampling is warranted based on the Phase 1 sample results, up to 15 samples may be collected and analyzed for the presence of lead.
		Percent Moisture	ASTM D2216			
		Percent Lipids	SW-846 3545			
Groundwater Monitoring	Middle of well Screen	Total and dissolved Lead	SW-846 3050B, 6010C	Up to 6	If Phase 1 sample results indicate that lead and/or PAHs are leaching into the subsurface, permanent groundwater wells will be installed and sampled to determine whether site groundwater has been impacted.	If groundwater sampling is warranted based on the Phase 1 sample results, up to 6 groundwater monitoring wells will be installed and sampled for the presence of site contaminants. At least one of the six permanent groundwater monitoring wells will be installed upgradient of the site to evaluate the background concentrations of lead and/or PAHs in groundwater which are not attributable to the skeet and trap range.
		PAHs	SW-846 8270D SIM			

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SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Sampling Station	Sample Identification (ID)	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference ¹
Phase 1 Soil and Sediment Sampling						
DNSTR-SO26	DNSTR-SS26-MMY	Surface Soil	0 – 12 inches bgs	PAHs, TOC, and pellet/clay target count	3 Field Samples Field Duplicate – SS27	Refer to Worksheet #21
DNSTR-SO27	DNSTR-SS27-MMY					
	DNSTR-SS27P-MMY					
DNSTR-SO28	DNSTR-SS28-MMY					
DNSTR-SO29	DNSTR-SS29-MMY					
DNSTR-SO30	DNSTR-SS30-MMY					
	DNSTR-SS30P-MMY					
DNSTR-SO31	DNSTR-SS31-MMY					
DNSTR-SO32	DNSTR-SS32-MMY					
DNSTR-SO33	DNSTR-SS33-MMY					
DNSTR-SO34	DNSTR-SS34-MMY					
	DNSTR-SS34-MMY-MS					
	DNSTR-SS34-MMY-SD					
DNSTR-SO35	DNSTR-SS35-MMY					
DNSTR-SO36	DNSTR-SS36-MMY					
DNSTR-SO37	DNSTR-SS37-MMY					
DNSTR-SO38	DNSTR-SS38-MMY					
DNSTR-SO39	DNSTR-SS39-MMY					
DNSTR-SO40	DNSTR-SS40-MMY					
DNSTR-SO41	DNSTR-SS41-MMY					
DNSTR-SO42	DNSTR-SS42-MMY					
DNSTR-SO43	DNSTR-SS43-MMY					
DNSTR-SO44	DNSTR-SS44-MMY					
	DNSTR-SS44P-MMY					
DNSTR-SO45	DNSTR-SS45-MMY					
DNSTR-SO46	DNSTR-SS46-MMY					
DNSTR-SO47	DNSTR-SS47-MMY					
DNSTR-SO48	DNSTR-SS48-MMY					
DNSTR-SO49	DNSTR-SS49-MMY					
	DNSTR-SS49-MMY-MS					
	DNSTR-SS49-MMY-SD					

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Sampling Station	Sample Identification (ID)	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference ¹		
DNSTR-SO50	DNSTR-SS50-MMY							
DNSTR-SO51	DNSTR-SS51-MMY							
DNSTR-SO52	DNSTR-SS52-MMY							
DNSTR-SO53	DNSTR-SS53-MMY			Grit Characterization	3 Composite Samples			
DNSTR-SO54	DNSTR-SS54-MMY							
DNSTR-SO55	DNSTR-SS55-MMY							
DNSTR-SO26	DNSTR-SB26-TD-BD-MMY	Subsurface Soil	12-24 inches bgs	PAHs and TOC	3 Field Samples Field Duplicate – SS28	Refer to Worksheet #21		
DNSTR-SO27	DNSTR-SB27-TD-BD-MMY							
DNSTR-SO28	DNSTR-SB28-TD-BD-MMY							
	DNSTR-SB28P-TD-BD-MMY							
DNSTR-SO29	DNSTR-SB29-TD-BD-MMY			PAHs, Lead, TOC, and pH	9 Field Samples Field Duplicate – SS31 MS/MSD – SS35			
DNSTR-SO30	DNSTR-SB30-TD-BD-MMY							
DNSTR-SO31	DNSTR-SB31-TD-BD-MMY							
	DNSTR-SB31P-TD-BD-MMY							
DNSTR-SO32	DNSTR-SB32-TD-BD-MMY							
DNSTR-SO33	DNSTR-SB33-TD-BD-MMY							
DNSTR-SO34	DNSTR-SB34-TD-BD-MMY							
DNSTR-SO35	DNSTR-SB35-TD-BD-MMY							
	DNSTR-SB35-TD-BD-MMY-MS							
	DNSTR-SB35-TD-BD-MMY-SD							
DNSTR-SO36	DNSTR-SB36-TD-BD-MMY							
DNSTR-SO37	DNSTR-SB37-TD-BD-MMY							
DNSTR-SO38	DNSTR-SB38-TD-BD-MMY						Lead and pH	15 Field Samples Field Duplicate – SS45 MS/MSD – SS50
DNSTR-SO39	DNSTR-SB39-TD-BD-MMY							
DNSTR-SO40	DNSTR-SB40-TD-BD-MMY							
DNSTR-SO41	DNSTR-SB41-TD-BD-MMY							
DNSTR-SO42	DNSTR-SB42-TD-BD-MMY							
DNSTR-SO43	DNSTR-SB43-TD-BD-MMY							
DNSTR-SO44	DNSTR-SB44-TD-BD-MMY							
DNSTR-SO45	DNSTR-SB45-TD-BD-MMY							
	DNSTR-SB45P-TD-BD-MMY							
DNSTR-SO46	DNSTR-SB46-TD-BD-MMY							
DNSTR-SO47	DNSTR-SB47-TD-BD-MMY							
DNSTR-SO48	DNSTR-SB48-TD-BD-MMY							

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Sampling Station	Sample Identification (ID)	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference ¹
DNSTR-SO49	DNSTR-SB49-TD-BD-MMY					
DNSTR-SO50	DNSTR-SB50-TD-BD-MMY					
	DNSTR-SB50-TD-BD-MMY-MS					
	DNSTR-SB50-TD-BD-MMY-SD					
DNSTR-SO51	DNSTR-SB51-TD-BD-MMY					
DNSTR-SO52	DNSTR-SB52-TD-BD-MMY					
DNSTR-SO26	DNSTR-SB26-TD-BD-MMY	Subsurface Soil	24-48 inches bgs	PAHs	3 Field Samples Field Duplicate – SS26	Refer to Worksheet #21
	DNSTR-SB26P-TD-BD-MMY					
DNSTR-SO27	DNSTR-SB27-TD-BD-MMY					
DNSTR-SO28	DNSTR-SB28-TD-BD-MMY					
DNSTR-SO29	DNSTR-SB29-TD-BD-MMY			PAHs, Lead, and pH	9 Field Samples Field Duplicate – SS32 MS/MSD – SS36	
DNSTR-SO30	DNSTR-SB30-TD-BD-MMY					
DNSTR-SO31	DNSTR-SB31-TD-BD-MMY					
DNSTR-SO32	DNSTR-SB32-TD-BD-MMY					
	DNSTR-SB32P-TD-BD-MMY					
DNSTR-SO33	DNSTR-SB33-TD-BD-MMY					
DNSTR-SO34	DNSTR-SB34-TD-BD-MMY					
DNSTR-SO35	DNSTR-SB35-TD-BD-MMY					
DNSTR-SO36	DNSTR-SB36-TD-BD-MMY					
	DNSTR-SB36-TD-BD-MMY-MS					
	DNSTR-SB36-TD-BD-MMY-SD					
DNSTR-SO37	DNSTR-SB37-TD-BD-MMY					
DNSTR-SO38	DNSTR-SB38-TD-BD-MMY					
DNSTR-SO39	DNSTR-SB39-TD-BD-MMY					
DNSTR-SO40	DNSTR-SB40-TD-BD-MMY					
DNSTR-SO41	DNSTR-SB41-TD-BD-MMY					
DNSTR-SO42	DNSTR-SB42-TD-BD-MMY					
DNSTR-SO43	DNSTR-SB43-TD-BD-MMY					
DNSTR-SO44	DNSTR-SB44-TD-BD-MMY					
DNSTR-SO45	DNSTR-SB45-TD-BD-MMY					
DNSTR-SO46	DNSTR-SB46-TD-BD-MMY					
	DNSTR-SB46P-TD-BD-MMY					
DNSTR-SO47	DNSTR-SB47-TD-BD-MMY					
DNSTR-SO48	DNSTR-SB48-TD-BD-MMY					

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Sampling Station	Sample Identification (ID)	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference ¹
DNSTR-SO49	DNSTR-SB49-TD-BD-MMY					
DNSTR-SO50	DNSTR-SB50-TD-BD-MMY					
DNSTR-SO51	DNSTR-SB51-TD-BD-MMY					
	DNSTR-SB51-TD-BD-MMY-MS					
	DNSTR-SB51-TD-BD-MMY-SD					
DNSTR-SO52	DNSTR-SB52-TD-BD-MMY	Surface Sediment	0-6 inches bgs	PAHs, Lead, TOC, pH, AVS/SEM, grain size, and pellet/clay target count	7 Field Samples Field Duplicate – SD24 MS/MSD – SD26	
DNSTR-SD21	DNSTR-SD21-TD-BD-MMY					
DNSTR-SD22	DNSTR-SD22-TD-BD-MMY					
DNSTR-SD23	DNSTR-SD23-TD-BD-MMY					
DNSTR-SD24	DNSTR-SD24-TD-BD-MMY					
	DNSTR-SD24P-TD-BD-MMY					
DNSTR-SD25	DNSTR-SD25-TD-BD-MMY					
DNSTR-SD26	DNSTR-SD26-TD-BD-MMY					
	DNSTR-SD26-TD-BD-MMY-MS					
	DNSTR-SD26-TD-BD-MMY-SD					
DNSTR-SD27	DNSTR-SD27-TD-BD-MMY			Lead, pH, AVS/SEM, grain size, and pellet/clay target count	14 Field Samples Field Duplicates – SD34, SD40 MS/MSD – SD36	Refer to Worksheet #21
DNSTR-SD28	DNSTR-SD28-TD-BD-MMY					
DNSTR-SD29	DNSTR-SD29-TD-BD-MMY					
DNSTR-SD30	DNSTR-SD30-TD-BD-MMY					
DNSTR-SD31	DNSTR-SD31-TD-BD-MMY					
DNSTR-SD32	DNSTR-SD32-TD-BD-MMY					
DNSTR-SD33	DNSTR-SD33-TD-BD-MMY					
DNSTR-SD34	DNSTR-SD34-TD-BD-MMY					
	DNSTR-SD34P-TD-BD-MMY					
DNSTR-SD35	DNSTR-SD35-TD-BD-MMY					
DNSTR-SD36	DNSTR-SD36-TD-BD-MMY					
	DNSTR-SD36-TD-BD-MMY-MS					
	DNSTR-SD36-TD-BD-MMY-SD					
DNSTR-SD37	DNSTR-SD37-TD-BD-MMY					
DNSTR-SD38	DNSTR-SD38-TD-BD-MMY					
DNSTR-SD39	DNSTR-SD39-TD-BD-MMY					
DNSTR-SD40	DNSTR-SD40-TD-BD-MMY					
	DNSTR-SD40P-TD-BD-MMY					

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Sampling Station	Sample Identification (ID)	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference ¹
DNSTR-SD41	DNSTR-SD41-TD-BD-MMY					
DNSTR-SDXX	DNSTR-SDXX-TD-BD-MMY	Subsurface Sediment (optional) ²	TBD	TBD	TBD	
Phase 2 Soil, Sediment, Groundwater, and Tissue Sampling						
DNSTR-SOXX	DNSTR-SSXX-MMY	Surface Soil (optional) ³	0 – 12 inches bgs	TBD	TBD	
DNSTR-SDXX	DNSTR-SDXX-MMY	Surface Sediment (optional) ³	0-6 inches bgs	TBD	TBD	
DNSTR-GWXX	DNSTR-GWXX-MMY	Groundwater (optional) ³	Middle of screen	Total and dissolved lead and/or PAHs	TBD	
DNSTR-TSXX	DNSTR-TSXX-MMY	Earthworm Tissue (optional) ³	N/A	Lead, percent moisture, and percent lipids	TBD	
DNSTR-TSXX	DNSTR-TSXX-MMY	Fish Tissue (optional) ³	N/A	Lead, percent moisture, and percent lipids	TBD	

Notes:

¹ Additional nomenclature instructions are as follows.

- field duplicates will have "P" added after the station indicator, for example: DNSTR-SS01P-MMY
- for soil samples collected from depths other than 0-12 inches bgs (surface soil), sample IDs will include the top depth and bottom depth in two-digit feet bgs; this is indicated in sample IDs by “TB-BD.”
- for sediments samples collected at multiple depths, sample IDs will include the top depth and bottom depth in two-digit feet bgs; this is indicated in sample IDs by “TB-BD.”
- for all sample IDs, "MMY" will be replaced with the two-digit month and year in which the sample was collected
- equipment blanks will be identified with the two digit month, day and year, and what matrix it is relevant to, for example: DNSTR-EBMMDDYY

² Phase 1 subsurface soil samples may be collected if sediment push cores identify lead shot and clay target fragments within the subsurface sediment.

³ The Phase 2 sample media, analytes, and number of samples will be determined based on the Phase 1 RI sampling and risk screening results.

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SAP Worksheet #19—Field Sampling Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical/Prep Method / SOP Reference	Containers (Number, Size, and Type)	Minimum Sample Amount Required for Analysis	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time ² (Preparation/Analysis)
Groundwater	PAHs	SW846 3510C or 3520C,	Two 1-liter (L) amber glass bottles	1000 milliliters (ml)	Cool to ≤ 6 °C	7 days to extraction
		8270D SIM / CA-213, CA-502				40 days to analysis
	Total Metal (Pb only)	SW846 3010A, 6010C / CA-604, CA-608	One 250-ml polyethylene bottle	50 ml	Nitric Acid to pH<2.	6 months to analysis
	Dissolve Metal (Pb only)	SW846 3010A, 6010C / CA-604, CA-608	One 250-ml polyethylene bottle	50 ml	Nitric Acid to pH<2.	6 months to analysis
Surface Soil and Subsurface Soil	PAHs	SW846 3540C or 3550C,	4-ounce (oz) wide-mouth jar	30 grams (g)	Cool to ≤ 6 °C	14 days to extraction, 40 days to analysis
		8270D SIM / CA-213, CA-512 or CA-526				
	Total Metal (Pb only)	SW846 3050B, 6010C / CA-605, CA-608	4-oz wide-mouth jar	2 g	None	6 months to analysis
	TOC	Lloyd Kahn / CA-741		0.5 g	Cool to ≤ 6 °C	28 days to analysis
Surface Sediment/ Subsurface Sediment	pH	SW-846 9045 C, 9045D / CA 709	2-oz wide-mouth jar	25g	Cool to ≤ 6 °C	28 days to analysis
	PAHs	8270D SIM / CA-213, CA-512 or CA-526	4-oz wide-mouth jar	30 g	Cool to ≤ 6 °C	14 days to extraction, 40 days to analysis
	Total Metal (Pb only)	SW846 3050B, 6010C / CA-605, CA-608	4-oz wide-mouth jar	2 g	None	6 months to analysis
	TOC	Lloyd Kahn / CA-741		0.5 g	Cool to ≤ 6 °C	28 days to analysis
	pH	SW-846 9045 C, 9045D / CA 709	2-oz wide-mouth jar	25g	Cool to ≤ 6 °C	28 days to analysis
	Grain Size	ASTM D 422-63 BR-GT-006(A)	Glass or Plastic	500 g	N/A	N/A
	Atterberg Limits	ASTM D 4318-05 BR-GT-011			N/A	N/A
	USCS Classification	ASTM D 2487-06 BR-GT-013			N/A	N/A
	Material in Soil Finer Than #200 Sieve	ASTM D 1140-00 BR-GT-017			N/A	N/A
	AVS-SEM	EPA 821/R-91-100 / CA-738	2-oz wide-mouth jar	10 g	Protected from oxygen, Cool to ≤ 6 °C	14 days to analysis
	Ammonia (as N) ³	EPA 350.1 / CA-770	4- oz wide-mouth jar	1 g	Cool to ≤ 6 °C	28 days to analysis
	Sulfide ³	EPA 376.1/ SW 4500-S2-F	4- oz wide-mouth jar	114 g (fill jar)	Cool to ≤ 6 °C	14 days to analysis
Earthworm Tissue ¹	Target Analyte List (TAL) Metal (Pb only)	SW846 3050B, 6010C / CA-605, CA-608	4-oz wide-mouth jar	2 g	None	6 months to analysis
	% Lipids	SW846 3545 / CA-538		5 g	(4 ± 2) °C	14 days to analysis
	% Moisture	ASTM D2216 / CA-717		1 g	(4 ± 2) °C	28 days to analysis
Fish Tissue ¹	TAL Metal (Pb only)	SW846 3050B, 6010C / CA-605, CA-608	resealable plastic bag	TBD	None	6 months to analysis
	% Lipids	SW846 3545 / CA-538		TBD	(4 ± 2) °C	14 days to analysis
	% Moisture	ASTM D2216 / CA-717		TBD	(4 ± 2) °C	28 days to analysis

SAP Worksheet #19—Field Sampling Requirements Table (continued)

Matrix	Analytical Group	Analytical/Prep Method / SOP Reference	Containers (Number, Size, and Type)	Minimum Sample Amount Required for Analysis	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time ² (Preparation/Analysis)
Soil (Earthworm)	Eisenia fetida (28 day exposure)	ASTM. 2012. Standard Guide for Conducting Laboratory Soil Toxicity or Bioaccumulation Tests with the Lumbricid Earthworm, Eisenia fetida and the Enchytraeid Potworm Enchytaeus albidus. E1676-04	1 gallon plastic pail per sample site	1 gallon per sample site	4°C	6 Weeks recommended, 8 Weeks maximum
Sediment (Earthworm)	Hyalella azteca (28 day exposure)	USEPA. 2000. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates. Second Edition. EPA/R-99/064. March 2000. ASTM. 2012. Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates. E 1706-05,	1 gallon plastic pail per sample site	1 gallon per sample site	4°C	6 Weeks recommended, 8 Weeks maximum

Notes

¹To reduce sampling efforts tissues samples will be collected at approximately the same time as other environmental media. Tissue samples will be filleted is appropriate and frozen at the laboratory upon receipt.

² Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted. (Not VTSR)

³ Ammonia and Sulfide will be tested for surface sediment only

SAP Worksheet #20-1—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/ MSDs	No. of Equipment Blanks	No. of Trip Blanks	Total No. of Samples to Lab ³
Surface Soil ¹	Metals (Pb only)	24	3	2/2	5	-	36
	PAH	12	2	1/1	5	-	21
	pH	24	3	2/2	-	-	31
	TOC	12	2	1/1	-	-	16
	Pellet Counts/ Clay target Counts	27	-	-	-	-	27
	Grit Characterization Analysis	3	-	-	-	-	3
Subsurface Soil ¹	Metals (Pb only)	48	5	3/3	5	-	64
	PAH	24	3	2/2	5	-	36
	pH	48	5	-	-	-	53
	TOC	12	2	-	-	-	14
Surface Sediment ¹	Metals (Pb only)	21	3	2/2	5	-	33
	PAH	7	1	1/1	2	-	12
	pH	21	3	2/2	-	-	28
	TOC	7	1	1/1	-	-	10
	AVS/SEM	21	3	-	-	-	24
	Grainsize	21	3	-	-	-	21
	Pellet Counts/ Clay target Counts	21	-	-	-	-	21
Subsurface sediment (optional) ¹	Metals (Pb only)	21	3	2/2	5	-	33
	PAH	7	1	1/1	2	-	12
	pH	21	3	2/2	-	-	28
	TOC	7	1	1/1	-	-	10
	AVS/SEM	21	3	-	-	-	24
	Grainsize	21	3	-	-	-	21

SAP Worksheet #20-2—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/ MSDs	No. of Equipment Blanks	No. of Trip Blanks	Total No. of Samples to Lab ³
Surface Soil (optional) ²	Metals (Pb only)	15	2	2/2	6	-	27
	PAH	15	2	2/2	6	-	27
	pH	15	2	1/1	-	-	19
	TOC	15	2	1/1	-	-	19
	Pellet Counts/ Clay target Counts	15	-	-	-	-	15
Surface Sediment (optional) ²	Metals (Pb only)	12	2	1/1	6	-	22
	PAH	12	2	1/1	6	-	22
	pH	12	2	1/1	-	-	16
	TOC	12	2	1/1	-	-	16
	AVS/SEM	12	2	1/1	-	-	16
	Grainsize	12	2	1/1	-	-	16
	Sulfide	12	2	1/1	-	-	16
	Ammonia	12	2	1/1	-	-	16
	Pellet Counts/ Clay target Counts	12	-	-	-	-	12
Groundwater (optional) ²	PAH	6	1	1/1	1	-	10
	Metals	6	1	1/1	1	-	10
	Dissolved Metals	6	1	1/1	1	-	10
Surface Soil Toxicity Test (Earthworm) (optional) ²	Eisenia fetida (28 day exposure)	15	-	-	-	-	15
Surface Sediment Toxicity Test (Amphipod) (optional) ²	Hyalella azteca (28 day exposure)	12	-	-	-	-	12
Earthworm Tissue (optional) ²	Metal (Pb only)	15	-	1/1	-	-	17
	Percent Lipids	15	-	1/1	-	-	17
	Percent Moisture	15	-	1/1	-	-	17
Fish Tissue (optional) ²	Metal (Pb only)	15	-	1/1	-	-	17
	Percent Lipids	15	-	1/1	-	-	17
	Percent Moisture	15	-	1/1	-	-	17

Notes:

¹ Phase One Sampling Event

² Phase Two Sampling Event

³ The number of field QC samples to be collected is dependent on the number of parent samples and the number of days of the sampling event.

- Field duplicates are collected at a frequency of 1 per 10 field samples per matrix.
- MS/MSD pairs are collected at a frequency of 1 per 20 samples per matrix sent to the laboratory (including duplicates).
- Equipment Blanks for decontaminated equipment are collected once per day of sampling, per type of equipment.; and once per lot for disposable equipment
- Field Blanks will not be collected as part of this investigation.

SAP Worksheet #21—Project Sampling SOP References Table

[\(UFP-QAPP Manual Section 3.1.2\)](#)

Reference	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)
BlankPrep	<i>Equipment Blank and Field Blank Preparation 8/2013</i>	CH2M HILL	Lab grade water, gloves, sample bottles	N
COC	<i>Chain-of-custody, 8/2013</i>	CH2M HILL	Bottle labels, indelible pen, blank chain-of-custody form, sample cooler, ice, temperature blank, packaging tape, zip-lock bags	N
DeconRig	<i>Decontamination of Drilling Rigs and Equipment, 8/2013</i>	CH2M HILL	Drill rig, water level meter, probes,alconox, methanol, distilled water, spray bottles	N
Dispose	<i>Disposal of Waste Fluids and Solids, 8/2013</i>	CH2M HILL	Fluids – 55-gallon drum, tools to secure drum, funnel, labels, marking pen, seals for drum Solids – 55-gallon drum, tools to secure drum, plastic sheets, labels, marking pen, seals for drum	N
DrumSample	<i>Sampling Contents of Tanks and Drums, 8/2013</i>	CH2M HILL	Drum/tank, sampling instrument, gloves, plastic sheets, labels, monitoring instrument	N
DPSoil	<i>Direct-Push Soil Sample Collection, 8/2013</i>		Truck-mounted hydraulic percussion hammer, sampling rods, sampling tubes and acetate liners, sample bottles, PPE	N
Fish-Sampling_Electroshocking	<i>Fish Sampling Using Electroshocking Techniques, 08/2013</i>	CH2M HILL	Boat-mounted or backpack electroshocker, seines, hip boots or chest waders, outer and inner rubber gloves, measuring board, scales, species sampling keys, live well, sample jars, camera, portable air pump, hand tools	N
Fish-Sampling Gill-Net	<i>Fish Sampling Using Gill Nets, 08/2013</i>	CH2M HILL	Sampling boat, gill nets, flotation and weights for nets, measuring board, scales, species sampling keys, live well, sample jars, camera, portable air pump, hand tools	N
Fish-Sampling_Seine	<i>Fish Sampling Using Seines, 08/2013</i>	CH2M HILL	Seine, measuring board, scales, species sampling keys, live well, sample jars, camera	N
LogBooks	<i>Preparing Field Log Books, 8/2013</i>	CH2M HILL	Log book, Indelible pen	N
Global positioning system (GPS)	<i>Global Positioning System, 8/2013</i>	CH2M HILL	Trimble GPS Unit	N
LowFlow-EPA Reg I&III	<i>Low-Flow Groundwater Sampling from Monitoring Wells – EPA Region I and III, 8 /2013</i>	CH2M HILL	Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump, Horiba U-22 or equivalent water quality meter, Flow-through cell with inlet/outlet ports, generator, water-level meter, disposable tubing, disposable filters, sample containers, graduated cylinder, plastic sheeting, log book, shipping supplies	N

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)
Homog	<i>Homogenization of Soil and Sediment Samples, 8/2013</i>	CH2M HILL	Sample containers, stainless steel spoons or spatulas, and stainless steel pans.	N
MiniRAE	<i>Mini RAE photoionization Detector (PID), 8/2013</i>	CH2M HILL	Operations manual, Minirae 2000, 100 parts per million (ppm) isobutylene as calibration gas, T-type feeder tube with regulator	N
MultiRAE_Plus_RevB1	<i>MultiRAE_Plus_RevB1—User's Manual, 11/2003</i>	Rae Systems	MultiRae, calibration gas, T-type feeder tube with regulator	N
MWInstall	<i>General Guidance for Monitoring Well Installation, 8/2013</i>	CH2M HILL	Drill rig, well construction materials (surface casing, screens, riser, casing, caps, bottom plugs, centering guides, sand, bentonite, grout, and surface finish materials, development equipment.	N
ShipLowConc	<i>Packaging and Shipping Procedures for Low-Concentration Samples, 8/2013</i>	CH2M HILL	Coolers, duct tape, ice, strapping tape, packaging material, Ziploc bags, custody seals, chain of custody	N
SBlog	<i>Logging of Soil Borings, 8/2013</i>	CH2M HILL	Indelible pens, tape measure or ruler, field logbook, spatula, soil color chart, grain size chart, Unified Soil Classification System index charts	N
SedSamp	<i>Sediment Sampling, 8/2013</i>	CH2M HILL	Stainless-steel trowel, stainless steel bowl, sample bottles, gloves	N
Soils	<i>Soil Sampling, 8/2013</i>	CH2M HILL	Stainless-steel trowel, thin-walled sampling tubes, drilling rig, stainless steel bowl, sample bottles	N
Utility Location_General	<i>Locating and Clearing Underground Utilities, 8/2013</i>	CH2M HILL	Subsurface locating instruments, spray paint (provided by utility locating contractor), historical documents, facility as built diagrams	N
WaterLevels	<i>Water-Level Measurements, 8/2013</i>	CH2M HILL	Water level meter	N
WaterQual-Horiba_YSI	<i>Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a Horiba or YSI Water Quality Parameter Meter with Flow-through Cell, 8/2013</i>	CH2M HILL	Horiba water quality meter	N

SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

[\(UFP-QAPP Manual Section 3.1.2.4\)](#)

Field Equipment	Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
Horiba U-22 or equivalent	Check mechanical and electronic parts, verify system continuity, check battery, and clean probes Calibration check	Daily before use, at the end of the day, and when unstable readings occur	Stable readings after 3 minutes pH reads 4.0 ± 3 percent Conductivity reads 4.49 ± 3 percent Turbidity reads $0 \pm 3\%$	Clean probe with deionized water and calibrate again Do not use instrument if not able to calibrate properly	FTL	Water Qual-Horiba-YSI
MultRae		Daily, before use, and as atmospheric conditions change		Do not use instrument if not able to calibrate properly	FTL	
Groundwater sampling pumps and tubing	Visual inspection of equipment and materials	During each use	Maintained in good working order per manufacturers' recommendations	Replace Items	FTL	Low Flow

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SAP Worksheet #23—Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)

Lab SOP Number	Title, Revision Date and/or Number	Last Reviewed	Definitive or Screening Data	Matrix / Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM (i.e. "none")	Modified for Project Work (Y/N)
CA-213	Analysis of Semivolatile Organic Compounds (SVOCs) By: SW 846 Method 8270 – Modified For Selected Ion Monitoring (SIM), 03/13, Revision 11.		Definitive	Soil, Sediment / PAHs	Gas chromatograph/mass spectrometer (GC/MS)	Katahdin Analytical Services, Inc.	No Variance	N
CA-226	Analysis of SVOAs by Capillary Column GC/MS: SW-846 Method 8270D, 04/13, Revision 4.		Definitive	SVOCs	GC/MS	Katahdin Analytical Services, Inc.	No Variance	N
CA-502	Preparation Of Aqueous Samples For Extractable Semivolatile Analysis, 05/13, Revision 8.		Definitive	SVOCs and PAHs	N/A (extraction)	Katahdin Analytical Services, Inc.	No Variance	N
CA-512	Preparation Of Sediment/Soil Samples By Sonication Using Method 3550 For Subsequent Extractable Semi-Volatiles Analysis, 04/12, Revision 9.	03/13	Definitive	Soil, Sediment / PAHs	N/A (extraction)	Katahdin Analytical Services, Inc.	No Variance	N
CA-526	Preparation Of Sediment/Soil Samples By Soxhlet Extraction Using Method 3540 For Subsequent Extractable Semivolatile Analysis, 04/12, Revision 8.	03/13	Definitive	Soil, Sediment / PAHs	N/A (extraction)	Katahdin Analytical Services, Inc.	No Variance	N
CA-538	Determination of Total Percentage Lipid in Tissue Samples by Accelerated Solvent Extraction Using Method 3545, 12/10, Revision 2.	07/13	Definitive	Tissue / % Lipids	Accelerated Soxhlet Extractor (ASE)	Katahdin Analytical Services, Inc.	No Variance	N
CA-604	Acid Digestion of Aqueous Samples by USEPA Method 3010 for Inductively Coupled Plasma (ICP) Analysis of Total or Dissolved Metals, 04/10, Revision 5.	02/13	Definitive	TAL Metals	N/A (digestion)	Katahdin Analytical Services, Inc.	No Variance	N
CA-605	Acid Digestion of Solid Samples by USEPA Method 3050 for Metals by ICP-Atomic Emission Spectroscopy (AES) and Graphite Furnace Atomic Absorption (GFAA), 09/10, Revision 5.	02/13	Definitive	Soil, Sediment / TAL Metals	N/A (digestion)	Katahdin Analytical Services, Inc.	No Variance	N
CA-608	Trace Metals Analysis By ICP-AES Using USEPA Method 6010, 05/13, Revision 14.		Definitive	Water, Soil, Sediment/ TAL Metals	IICP–AES	Katahdin Analytical Services, Inc.	No Variance	N
CA-708	pH Concentration Measurements In Aqueous Samples, 05/12, Revision 6.	02/13	Definitive	pH	pH Meter	Katahdin Analytical Services, Inc.	No Variance	N
CA-709	pH Concentration Measurements In Soil Matrices – SW 846 Method 9045, 05/12, Revision 9.	02/13	Definitive	Soil, Sediment	pH Meter	Katahdin Analytical Services, Inc.	No Variance	N
CA-717	Total Solids/Total Volatile Solids Determination In Solid Matrices, 05/12, Revision 8.	02/13	Definitive	Tissue / % Moisture	Balance	Katahdin Analytical Services, Inc.		
CA-738	Determination of AVS and Simultaneously Extractable Metals in Sediments, 05/12, Revision 3.		Definitive	Soils, Sediments / AVS and Simultaneously Extractable Metals	Buret – AVSs	Katahdin Analytical Services, Inc.	No Variance	N
					ICP – Simultaneously Extractable Metals	Katahdin Analytical Services, Inc.		
CA-741	Determination of TOC in Solids Using the USEPA Region II Method Lloyd Kahn and SW846 9060 Mod., 02/13, Revision 5.		Definitive	Soil. Sediment / TOC	TOC Analyzer	Katahdin Analytical Services, Inc.	No Variance	N
CA-770	Colorimetric Analysis Of Ammonia-Nitrogen Using The Automated Konelab Multiwavelength Photometric Analyzer, 02/13, Revision 4.		Definitive	Soil, Sediment / Ammonia	Konelab	Katahdin Analytical Services, Inc.	No Variance	N
BR-GT-006	Particle Size Analysis (ASTM D 2217 and D422-63), Rev 6, 03/17/10		Screening	Solid / Sediments Geotechnical	N/A	TestAmerica- Burlington	No Variance	N

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SAP Worksheet #24—Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference ¹
GC/MS (full scan) SVOCs GC/MS (SIM) PAHs	Initial calibration (ICAL) – A minimum 5-point calibration is required for all SVOCs.	Instrument receipt, instrument change (new column, source cleaning, etc.), when continuing calibration verification (CCV) is out of criteria. Six-point ICAL for all analytes.	SVOCs (full scan): The average reporting factor (RF) for system performance check compounds (SPCCs) must be > 0.050; The %relative standard deviation (RSD) for RFs for calibration check compounds (CCCs) must be <30%, and one option below must be met: Option 1) %RSD < 15% for all compounds. If not met: Option 2) Linear least squares regression: $r \leq 0.995$ Option 3) Non-linear regression: $r^2 \leq 0.99$ (6 points for second order). SVOCs (SIM) – Project-specific criteria: The average RF for all project compounds must be ≥ 0.050 . The %RSD for all project compounds must be $\leq 30\%$. If not met, Option 2 or Option 3 above must be met.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Department Manager	CA-213, CA-226
	Initial calibration verification (ICV)	Once after each ICAL.	The %R must be within 80-120% for all project compounds.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst, Department Manager	
	CCV	Analyze a standard at the beginning of each 12-hour shift after a decafluorotriphenylphosphine (DFTPP) tune.	SVOCs (except PAHs): The RF for SPCCs must be ≥ 0.050 ; The %D for all target compounds and surrogates must be $\leq 20\%D$ (D = Difference or Drift) PAHs – Project-specific criteria: The RF for all project compounds must be > 0.050 . The %D for all project compounds and surrogates must be $\leq 25\%D$. (D = Difference or Drift)	DoD project level approval must be obtained for each of the failed analytes or CA must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	Analyst, Department Manager	
	DFTPP Tune	Every 12 hours	Criteria listed in Section 7.4, current revision of SOPs CA-204 and CA-213	Retune and/or clean source.	Analyst, Department Manager	
ICP-AES – TAL Metals	ICAL	At the beginning of each day or if QC is out of criteria.	One point calibration plus a blank per manufacturer’s guidelines.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards.	Analyst, Department Manager	CA-608
	ICV	Once after each ICAL, prior to beginning a sample run.	%R must be within 90-110% for all project compounds.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Department Manager	
	Calibration Blank (CCB)	Before beginning a sample sequence, after every 10 samples and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Department Manager	
	CCV	After every 10 samples and at the end of each run sequence.	%R must be within 90-110% for all project compounds.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Department Manager	
	Low-level Calibration Check Standard (if using one-point ICAL)	Daily after one-point ICAL.	%R must within 80%-120% for all project compounds.	Correct problem, then reanalyze.	Analyst, Department Manager	
	ICS – ICSA & ICSB	Daily, before sample injections	ICSA recoveries must be less than the absolute value of the LOD and ICSB %Rs must be within 80-120%.	Correct the problem, then re-prepare checks and reanalyze all affected samples.	Analyst, Department Manager	

SAP Worksheet #24—Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference ¹
Konelab –Ammonia	ICAL – Minimum of a 5-point calibration curve plus a blank is prepared.	Daily ICAL prior to sample analysis.	Correlation coefficient ® must be ≤ 0.995.	Correct problem, then repeat ICAL.	Analyst, Department Manager	CA-770
	ICV	Once after each ICAL, prior to beginning a sample run.	Ammonia: %R must be within 90-110%.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst, Department Manager	
	CCV	CCV	One after every 10 samples analyzed and at close of run	90%-110 % rcvy.	Analyst, Department Manager	
TOC Analyzer / TOC	ICAL – Minimum of a 5-point calibration curve plus a blank is prepared.	Initially, when the daily CCV does not pass, but, no longer than every 3 months.	Correlation coefficient ≤ 0.995	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards	Analyst, Department Manager	CA741
	ICV	Once after each ICAL, prior to beginning a sample run.	Lloyd Kahn: %R must within 80%-120%	(1) If the ICV fails high, report samples that are <PQL.	Analyst, Department Manager	
			SM5310B: %R must within 90%-110%	(2) Redigest, recalibrate and/or reanalyze other samples.		
	CCV	Every 10 samples and at the end of the run	Lloyd Kahn: %R must within 80%-120%	If the CCV fails high, report samples that are <PQL. Recalibrate and/or reanalyze samples back to last acceptable CCV recovery.	Analyst, Department Manager	
			SM5310B: %R must within 90%-110%			
Spectrophotometer / AVS	ICAL – Minimum of a 5-point calibration curve plus a blank is prepared.	Prior to sample analysis	Linear Regression Correlation Coefficient ≥0.995	Investigate source of problem, Recalibrate	Analyst, Department Manager	CA-738
	ICV	One of each per prep batch	70-130 %R	Recalibrate and reanalyze sample batch	Analyst, Department Manager	
	CCV	At beginning of run, after every 10 samples and at the end of the run	80-120 %R	Reanalyze all samples back to last acceptable CCV recovery	Analyst, Department Manager	
Balance / Total Solids	Balance Verification	Every day before use.	Within criteria specified in KAS SOP CA-102.	Investigate problem. Do not use balance until verification has passed.	Analyst, Department Manager	CA-717
pH Meter	ICAL	Once per day	± 0.05 pH units for every buffer	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration	Analyst, Supervisor	CA-708, CA-709
Hydrometer ASTM D 422	Hydrometer Calibration	Once every two years	Must meet criteria in calibration log	Remove from service	Analyst	SOP BR-GT-008
Sieves ASTM D 422	Sieve Calibration	Once every six months	Tolerances per Table 1 in SOP	Remove from service	Analyst	SOP BR-GT-008

¹ Refer to Worksheet #23 for a complete reference to relevant analytical SOPs.

SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
GC/MS SVOCs (full scan and SIM)	Check pressure and gas supply daily. Manual tune if DFTPP not in criteria, change septa as needed, change liner as needed, cut column as needed. Other maintenance specified in lab Equipment Maintenance SOP.	SVOCs and PAHs	Ion source, injector liner, column, column flow.	Prior to ICAL and/or as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-213, CA-226
ICP-AES	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, replace peristaltic pump tubing as needed. Other maintenance specified in lab Equipment Maintenance SOP.	TAL Metals, SEM	Torch, nebulizer chamber, pump, pump tubing.	Prior to ICAL and as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-608
Konelab	Check and clean segments weekly, clean reagent tubes monthly. Change lamp, change diluent and wash tubes, change mixing paddles and syringes, change dispensing needle, all as needed.	Reactive Cyanide, Ammonia,	Reagent tubes, lamp, wash tubes, paddles, syringes, dispensing needles.	Prior to ICAL and/or as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-770, CA-773
TOC Combustion Analyzer	Check level of dilution water, drain vessel water, humidifier water, auto sampler rinse water and phosphoric acid vessel and fill as needed. Replace oxygen cylinder.	TOC	Tubing, sample boat, syringe, humidifier, rinse reservoir, phosphoric acid vessel, oxygen pressure	Prior to ICAL and as necessary	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-741
Spectrophotometer	Clear cuvettes and lense as necessary. Outside calibration annually.	AVS	Cuvettes, cuvette holder, lenses	As necessary	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-738
Balance	Weights	Total Solids	Cleanliness	Prior to sample weighing	Acceptable CCV	Correct the problem, reanalyze CCV.	Analyst, Department Manager	CA-717
Probe - pH	Clean, drain, and refill reference electrode as needed.	pH	Reference electrode for white crystals, Inspect electrode for damage.	Before use	pH 7 ± 0.05 pH units (pH)	Correct problem and repeat calibration.	Analyst, Department Manager	CA-708, CA-709
Hydrometer	Hydrometer Calibration	Hydrometer Calibration	Hydrometer Calibration	Once every two years	Must meet criteria in calibration log	Remove from service	Laboratory Analyst	SOP BR-GT-008
Sieves	Sieve Calibration	Sieve Calibration	Sieve Calibration	Once every six months	Tolerances per Table 1 in SOP	Remove from service	Laboratory Analyst	SOP BR-GT-008

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SAP Worksheet #26—Sample Handling System

[\(UFP-QAPP Manual Appendix A\)](#)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Field Team/CH2M HILL Sample Packaging (Personnel/Organization): FTL/ CH2M HILL Coordination of Shipment (Personnel/Organization): FTL/ CH2M HILL Type of Shipment/Carrier: Overnight Carrier/ FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodians / Katahdin Analytical Services Sample Custody and Storage (Personnel/Organization): Sample Custodians / Katahdin Sample Preparation (Personnel/Organization): Extraction Lab, Metals Preparation Lab / Katahdin Analytical Services Sample Determinative Analysis (Personnel/Organization): GC/MS, gas chromatograph, Metals and Wet Chemistry Laboratories / Katahdin Analytical Services
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 60 days from receipt Sample Extract/Digestate Storage (No. of days from extraction/digestion): 3 months from sample digestion or extraction Microbial Sample Storage (No. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodians / Katahdin Analytical Services Number of Days from Analysis: 2 months from final report mail date

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SAP Worksheet #27—Sample Custody Requirements Table

[\(UFP-QAPP Manual Section 3.3.3\)](#)

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled. Labels will be taped to the containers to ensure they do not separate. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples <6 °C until they are received by the laboratory.

The chain of custody will be placed into the cooler in a Ziploc bag. Coolers will be taped up and shipped to the laboratories via Fed Ex overnight, with the air bill number indicated on the chain of custody (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples to CH2M HILL.

See **Worksheet #21** for SOPs containing sample custody guidance.

All samples will be shipped to Katahdin Analytical except grainsize, and toxicity samples. Grainsize samples will be shipped to Test America-Burlington-VT and toxicity samples will be shipped to EnviroSystems.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Laboratory custody procedures can be found in the laboratory SOPs, which are referenced in **Worksheet #23**. Laboratory SOPs will be provided upon request.

Sample ID Procedures:

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservation, and sampler's initials. The field logbook will identify the sample ID with the location and time collected and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the chain of custody and **Worksheet #18**. The laboratory will send sample log-in forms to the PC to check that sample IDs and parameters are correct.

Chain of Custody Procedures:

Chains of custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID. Date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain-of-custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management Systems (LIMS) database for each sample.

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SAP Worksheet #28-1—Laboratory QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix: Soil, Sediment
Analytical Group: PAHs
Analytical Method/SOP Reference: SW846 8270D SIM

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparation batch of twenty or fewer samples of similar matrix.	No target compounds > ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Reprepate and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager, and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
Surrogate	SIM – 3 per sample: 2-Methylnaphthalene-d10 Fluorene-d10 Pyrene-d10	%R must be within DoD QSM limits, if available; otherwise, within laboratory’s statistically-derived QC limits.	For QC and field samples, correct problem then reprepate and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Contact Client if samples cannot be reprepated within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
LCS	One per preparation batch of twenty or fewer samples of similar matrix.	%R must be within DoD QSM limits, if available; otherwise, within laboratory’s statistically-derived QC limits. Allow for the number of marginal exceedances presented in DoD QSM Table G-1.	Correct problem, then reprepate and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix E-1). Contact Client if samples cannot be reprepated within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per sample delivery group (SDG) or every 20 samples.	%R should be within the same limits as for the LCS. RPD should be ≤ 30%.	CAs will not be taken for samples when recoveries are outside limits if likely due to matrix, otherwise contact client.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
IS	Six per sample: 1,4-Dichlorobenzene-d4 Naphthalene-d8 Acenaphthene-d10 Phenanthrene-d10 Chrysene-d12 Perylene-d12	Retention times for internal standards must be + 30 seconds and the responses within -50% to +100% of the ICAL midpoint.	Inspect mass spectrometer or gas chromatograph for malfunctions. Mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	N/A	Apply “J” qualifier to results between DL and LOQ.	N/A	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: Soil, Sediment
Analytical Group: Metals
Analytical Method/SOP Reference: SW846 6010C

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No target metals > ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater. For negative blanks, absolute value must be < LOD.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples of similar matrix (varies by lot).	%R must be within DoD QSM limits, allowing for the marginal exceedances presented in DoD QSM Table G-1.	Re-digest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
MS / MSD	One per SDG or every 20 samples.	%R should be within the DoD QSM limits for LCS, if sample < 4x spike added. RPD should be < / = 20%	Flag results for affected analytes for all associated samples with "N".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Post-digestion Spike	When dilution test fails or analyte concentration in all samples < 50x LOD	%R should be within 75-125%.	Run associated samples by method of standard addition or flag results.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
ICP Serial Dilution	One per preparation batch of 20 or fewer samples of similar matrix.	If original sample result is at least 50x LOQ, 5-fold dilution must agree within ± 10% of the original result.	Flag results for affected analytes for all associated samples with "E".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	N/A	Apply "J" qualifier to results between DL and LOQ.	N/A	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: Soil, Sediment
Analytical Group: pH
Analytical Method/SOP Reference: SW846 9545D

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per analytical batch of 20 or fewer samples.	No target analytes > LOQ and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per analytical batch of 20 or fewer samples.	Corrosivity - %R must be within 90-110	(1) Investigate source of problem. (2) If the LCS recovery is high but the sample results are <PQL, narrate. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One sample duplicate per 20 samples.	RPD ≤20 for samples >3X the PQL, <100% RPD for samples <3X the PQL.	(1) Investigate problem and reanalyze sample in duplicate (2) If RPD still >20, report original result with notation or narration.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: Soil, Sediment
Analytical Group: TOC
Analytical Method/SOP Reference: Lloyd Kahn

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per analytical batch of 20 or fewer samples.	No target analytes > LOQ and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per analytical batch of 20 or fewer samples.	%R must be within 85-115	(1) Investigate source of problem. (2) If the LCS recovery is high but the sample results are <PQL, narrate. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
MS	One for every set 10 samples (N/A for TDS)	%R must be within 80-120	(1) Evaluate the samples and associated QC: i.e. If the LCS results are acceptable, narrate. (2) If both the LCS and MS are unacceptable reprep and reanalyze the samples and QC. (3) Notate sample result in raw data if matrix interference suspected.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Quadruplicate	One sample quadruplicate per 20 samples.	RPD <30 for samples >3X the PQL, <100% RPD for samples <3X the PQL.	(1) Investigate problem and reanalyze sample in duplicate (2) If RPD still >20, report original result with notation or narration.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: Soil, Sediment
Analytical Group: AVS
Analytical Method/SOP Reference: EPA 821/R-91-100

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per prep batch of 20 or fewer samples	No analyte detected >LOQ	Investigate source of contamination. Reprep and analyze method blank and all samples processed with the contaminated blank	Analyst, Laboratory Department Manager, and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One of each per prep batch	80-120 %R	Recalibrate and reanalyze sample batch	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/bias	Same as Method/SOP QC Acceptance Limits.
MS	One for every set of 10 samples	75-125 %R	(1) Notate sample result in raw data with Notation I-1	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One sample duplicate per twenty samples or per batch	RPD \leq 20	If lab QC in criteria and matrix interference suspected, flag data. Else, reanalyze	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: Soil, Sediment
Analytical Group: Ammonia
Analytical Method/SOP Reference: EPA 350.1/350.2

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per analytical batch of 20 or fewer samples.	No target analytes > LOQ and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per analytical batch of 20 or fewer samples.	%R must be within 90-110	(1) Investigate source of problem. (2) If the LCS recovery is high but the sample results are <PQL, narrate. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
MS	One for every set 10 samples (N/A for TDS)	%R must be within: 85-115	(1) Evaluate the samples and associated QC: i.e. If the LCS results are acceptable, narrate. (2) If both the LCS and MS are unacceptable reprep and reanalyze the samples and QC. (3) Notate sample result in raw data if matrix interference suspected.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One sample duplicate per 20 samples.	RPD <20 for samples >3X the PQL, <100% RPD for samples <3X the PQL.	(1) Investigate problem and reanalyze sample in duplicate (2) If both the LCS and MS are unacceptable reprep and reanalyze the samples and QC. (3) Notate sample result in raw data if matrix interference suspected.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Water

Analytical Group: PAHs

Analytical Method/SOP Reference: SW846 8270D SIM

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparation batch of twenty or fewer samples of similar matrix.	No target compounds > ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Reprepate and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
Surrogate	SIM – 3 per sample: 2-Methylnaphthalene-d10 Fluorene-d10 Pyrene-d10	%R must be within DoD QSM limits, if available; otherwise, within laboratory’s statistically-derived QC limits.	For QC and field samples, correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Contact Client if samples cannot be reprepared within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
LCS	One per preparation batch of twenty or fewer samples of similar matrix.	%R must be within DoD QSM limits, if available; otherwise, within laboratory’s statistically-derived QC limits. Allow for the number of marginal exceedances presented in DoD QSM Table G-1.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix E-1). Contact Client if samples cannot be reprepared within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per SDG or every 20 samples.	%R should be within the same limits as for the LCS. RPD should be ≤ 30%.	CAs will not be taken for samples when recoveries are outside limits if likely due to matrix, otherwise contact client.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
IS	Six per sample: 1,4-Dichlorobenzene-d4 Naphthalene-d8 Acenaphthene-d10 Phenanthrene-d10 Chrysene-d12 Perylene-d12	Retention times for internal standards must be + 30 seconds and the responses within -50% to +100% of the ICAL midpoint.	Inspect mass spectrometer or gas chromatograph for malfunctions. Mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	N/A	Apply “J” qualifier to results between DL and LOQ.	N/A	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-2—Laboratory QC Samples Table (continued)

Matrix: Water
Analytical Group: Metals
Analytical Method/SOP Reference: SW846 6010C

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No target metals > ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater. For negative blanks, absolute value must be < LOD.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples of similar matrix (varies by lot).	%R must be within DoD QSM limits, allowing for the marginal exceedances presented in DoD QSM Table G-1.	Re-digest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
MS / MSD	One per SDG or every 20 samples.	%R should be within the DoD QSM limits for LCS, if sample < 4x spike added. RPD should be < / = 20%	Flag results for affected analytes for all associated samples with "N".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Post-digestion Spike	When dilution test fails or analyte concentration in all samples < 50x LOD	%R should be within 75-125%.	Run associated samples by method of standard addition or flag results.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
ICP Serial Dilution	One per preparation batch of 20 or fewer samples of similar matrix.	If original sample result is at least 50x LOQ, 5-fold dilution must agree within ± 10% of the original result.	Flag results for affected analytes for all associated samples with "E".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	N/A	Apply "J" qualifier to results between DL and LOQ.	N/A	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: Tissue

Analytical Group: PAHs

Analytical Method/SOP Reference: SW846 8270D SIM

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparation batch of twenty or fewer samples of similar matrix.	No target compounds > ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Reprepate and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
Surrogate	<u>SIM</u> – 3 per sample: 2-Methylnaphthalene-d10 Fluorene-d10 Pyrene-d10	%R must be within DoD QSM limits, if available; otherwise, within laboratory’s statistically-derived QC limits.	For QC and field samples, correct problem then reprepate and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Contact Client if samples cannot be reprepated within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
LCS	One per preparation batch of twenty or fewer samples of similar matrix.	%R must be within DoD QSM limits, if available; otherwise, within laboratory’s statistically-derived QC limits. Allow for the number of marginal exceedances presented in DoD QSM Table G-1.	Correct problem, then reprepate and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix E-1). Contact Client if samples cannot be reprepated within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per SDG or every 20 samples.	%R should be within the same limits as for the LCS. RPD should be ≤ 30%.	CAs will not be taken for samples when recoveries are outside limits if likely due to matrix, otherwise contact client.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
IS	Six per sample: 1,4-Dichlorobenzene-d4 Naphthalene-d8 Acenaphthene-d10 Phenanthrene-d10 Chrysene-d12 Perylene-d12	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of the ICAL midpoint.	Inspect mass spectrometer or gas chromatograph for malfunctions. Mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	N/A	Apply “J” qualifier to results between DL and LOQ.	N/A	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-3—Laboratory QC Samples Table (continued)

Matrix: Tissue
Analytical Group: Metals
Analytical Method/SOP Reference: SW846 6010C

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria (MPC)
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No target metals> ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PSL, whichever is greater. For negative blanks, absolute value must be < LOD.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples of similar matrix (varies by lot).	%R must be within DoD QSM limits, allowing for the marginal exceedances presented in DoD QSM Table G-1.	Re-digest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.
MS / MSD	One per SDG or every 20 samples.	%R should be within the DoD QSM limits for LCS, if sample < 4x spike added. RPD should be </= 20%	Flag results for affected analytes for all associated samples with "N".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Post-digestion Spike	When dilution test fails or analyte concentration in all samples < 50x LOD	%R should be within 75-125%.	Run associated samples by method of standard addition or flag results.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
ICP Serial Dilution	One per preparation batch of 20 or fewer samples of similar matrix.	If original sample result is at least 50x LOQ, 5-fold dilution must agree within ± 10% of the original result.	Flag results for affected analytes for all associated samples with "E".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	N/A	Apply "J" qualifier to results between DL and LOQ.	N/A	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #29—Project Documents and Records Table

[\(UFP-QAPP Manual Section 3.5.1\)](#)

Sample Collection Documents and Records	Onsite Analysis Documents and Records	Offsite Analysis Documents and Records ¹	Data Assessment Documents and Records	Other
<ul style="list-style-type: none"> • Field Notebooks • Chain-of-Custody Records • Air Bills • Custody Seals • CA Forms • Electronic Data Deliverables (EDDs) • ID of QC Samples • Meteorological Data from Field (logging daily weather) • Sampling Instrument Calibration Logs • Sampling Locations and Sampling Plan • Sampling Notes and Drilling Logs 	<ul style="list-style-type: none"> • No onsite analysis will take place other than collecting measurements of water quality parameters. These readings will be recorded in field logbooks as they are collected 	<ul style="list-style-type: none"> • Sample Receipt, Chain-of-Custody, and Tracking Records • Standard Traceability Logs • Equipment Calibration Logs • Sample Prep Logs • Run Logs • Equipment Maintenance, Testing, and Inspection Logs • CA Forms • Reported Field Sample Results • Reported Result for Standards, QC Checks, and QC Samples • Instrument printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples • Data Package Completeness Checklists • Sample disposal records • Extraction/Clean-up Records • Raw Data (stored on disk) 	<ul style="list-style-type: none"> • Fixed Laboratory Audit Checklists • DV Reports • CA Forms • Laboratory QA Plan • Method detection limit (MDL) Study Information 	

Notes:

¹ Offsite documents except for analytical laboratory data are archived with Iron Mountain, Inc., which is headquartered at 745 Atlantic Avenue, Boston, MA 02111. Analytical laboratory data are archived with the Federal Records Center.

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SAP Worksheet #30—Analytical Services Table

[\(UFP-QAPP Manual Section 3.5.2.3\)](#)

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization
Soil and Sediment	PAHs	See Worksheet #18	SW846 3540C or 3550C, 8270D SIM / CA-213, CA-512 or CA-526	28 Days	Katahdin Analytical Jennifer Obrin 600 Technology Way Scarborough, Maine 04074 Direct - 207.874.2400 x17 Fax - 207.775.4029 Sulfide and Grainsize will be subcontracted to Test America (Grainsize will go to Burlington and Sulfide will go to Savannah.)
	TAL Metals (Lead only)		SW846 3050B, 6010C / CA-605, CA-608		
	TOC		Lloyd Kahn / CA-741		
	Ammonia (as N)		EPA 350.1 / CA-770		
	Sulfide		EPA 376.1/SW-846 9030/SM 4500-S2-F		
	AVS-SEM		EPA 821/R-91-100 / CA-738		
	Grain size		ASTM D422		
Groundwater	PAHs		SW846 3510C or 3520C, 8270D SIM / CA-213, CA-502		Test America - Burlington 30 Community Drive Suite 11 South Burlington, VT 05403 802.660.1990
	TAL Metals (Lead only)		SW846 3010A, 6010C / CA-604, CA-608		
Tissue	TAL Metals		SW846 3050B, 6010C / CA-605, CA-608		Test America - Savannah 5102 LaRoche Avenue Savannah, GA 31404 912.354.7858 Fax: 912.352.0165
	% Lipids		SW846 3545 / CA-538		
	% Moisture		ASTM D2216 / CA-717		
Soil (Earthworm)	Eisenia fetida (28 day exposure)		ASTM. 2012. Standard Guide for Conducting Laboratory Soil Toxicity or Bioaccumulation Tests with the Lumbricid Earthworm, Eisenia fetida and the Enchytraeid Potworm Enchytraeus albidus. E1676-04		EnviroSystems, Inc. P.O. Box 778 Hampton, NH 03843-0778 Voice: 603.926.3345 Ext 213 Mobile: 603.475-7564 Fax: 603.926.3521
Sediment (Earthworm)	Hyalella azteca (28 day exposure)		USEPA. 2000. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates. Second Edition. EPA/R-99/064. March 2000. ASTM. 2012. Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates. E 1706-05,		

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SAP Worksheet #31—Planned Project Assessments Table

[\(UFP-QAPP Manual Section 4.1.1\)](#)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CA (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Field QA and H&S Audit	Once	Internal	CH2M HILL	Stephen Brand	FTL and Field Staff	Stephen Brand	Brett Doerr Carl Woods
Onsite Laboratory Technical Systems Audit (applies to definitive data only)	Laboratory must have a current accreditation from the DoD ELAP, which will identify the period of performance and scope of analytical methods. The laboratory must be re-evaluated prior to expiration of period of performance	External	Third-Party Accrediting Body	Third Party Accrediting Body (TBD)	Respective Laboratory QAO	Respective Laboratory QAO	Anita Dodson, Program Chemist, CH2M HILL

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses Table

[\(UFP-QAPP Manual Section 4.1.2\)](#)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (name, title, organization)	Timeframe for Response
Field QA and H&S Audit	Checklist and Written Audit Report	Joe Kenderdine/ CH2M HILL, PM	Within 1 week of audit	Memorandum	TBD FTL CH2M HILL John Tomik AQM CH2M HILL	Within 1 week of receipt of CA Form
Onsite Laboratory Technical Systems Audit	Written audit report from DoD Laboratory Accrediting Body	Respective Laboratory QAO	Within 2 months of audit	Memorandum	DoD Laboratory Accrediting Body (TBD)	Within 2 months of receipt of initial notification

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SAP Worksheet #33—Quality Assurance Management Reports Table

[\(UFP QAPP Manual Section 4.2\)](#)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Technical Memorandum	Following Phase 1 sampling and data validation	TBD	Joe Kenderdine/CH2M HILL PM	Stakeholders, See Worksheet #3
RI Report	Post-field event	TBD	Joe Kenderdine/CH2M HILL PM	Stakeholders, See Worksheet #3

Notes:

The RI Report will address the following:

- Summary of project QA/QC requirements/procedures
- Conformance of project to UFP-SAP requirements/procedures
- Deviations from the UFP-SAP and approved amendments that were made
- Results of data review activities (how much usable data were generated)
- CAs if needed, and their effectiveness
- Data usability with regards to: precision, accuracy, representativeness, completeness, comparability, and sensitivity
- Limitations on data use

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SAP Worksheets #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process Table

(UFP-QAPP Manual Section 5.2.1), (UFP-QAPP Manual Section 5.2.2), (Figure 37 UFP-QAPP Manual), (Table 9 UFP-QAPP Manual)

Data Review Input	Description	Responsible for Verification	Step I / IIa / IIb ¹	Internal/ External ²
Field Notebooks	Field notebooks will be reviewed internally and placed into the project file for archival at project closeout.	FTL / CH2M HILL	Step I	Internal
Chains of Custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody will be initialed by the reviewer, a copy of the chains-of-custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment. Chains-of-custody will also be reviewed for adherence to the SAP by the PC.	FTL / CH2M HILL PC / CH2M HILL	Step I	Internal and External
Sample Condition upon Receipt	Any discrepancies, missing, or broken containers will be communicated to the PC in the form of laboratory logins.	PC / CH2M HILL	Step I	External
Documentation of Laboratory Method Deviations	Laboratory Method Deviations will be discussed and approved by the PC. Documentation will be incorporated into the case narrative which becomes part of the final hardcopy data package.	PC / CH2M HILL	Step I	External
EDDs	EDDs will be compared against hardcopy laboratory results (10% check).	PC / CH2M HILL	Step I	External
Case Narrative	Case narratives will be reviewed by the data validator during the DV process. This is verification that they were generated and applicable to the data packages.	Data Validator / CH2M HILL	Step I	External
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Respective Laboratory QAO	Step I	Internal
Laboratory Data	The data will be verified for completeness by the PC. In order to ensure completeness, EDDs will be compared to the SAP. This is verification that all samples were included in the laboratory data and that correct analyte lists were reported.	PC / CH2M HILL	Step I	External
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the site file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the site manager will be notified to ensure action is taken.	PM / CH2M HILL PC / CH2M HILL	Step I	Internal
CA Reports	CA reports will be reviewed by the PC or PM and placed into the project file for archival at project closeout.	PM / CH2M HILL PC / CH2M HILL	Step I	External
Laboratory Methods	Ensure the laboratory analyzed samples using the correct methods.	PC / CH2M HILL	Step IIa	External
Target Analytes	Ensure the laboratory reported all analytes from each analysis group.	PC / CH2M HILL	Step IIa	External
Reporting Limits	Ensure the laboratory met the project-designated QLs. If QLs were not met, the reason will be determined and documented.	PC / CH2M HILL	Step IIb	External
Field SOPs	Ensure that all field SOPs were followed.	FTL /CH2M HILL	Step IIa	Internal
Laboratory SOPs	Ensure that approved analytical laboratory SOPs were followed.	Respective Laboratory QAO	Step IIa	Internal

SAP Worksheets #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description	Responsible for Verification	Step I / IIa / IIb ¹	Internal/ External ²
Raw Data (specifically for Level IV Validation)	From each analytical suite containing definitive data, a 10 percent review of chromatograms and raw data will be performed to confirm laboratory calculations. For a recalculated result the data validator attempts to re-create the reported numerical value. Samples selected for this review will be at the discretion of the validator. The laboratory is asked for clarification if a discrepancy is identified which cannot reasonably be attributed to rounding. In general, this is outside 5% difference.	Data Validator / CH2M HILL	Step IIa	External
Onsite Screening	All non-analytical field data will be reviewed against SAP requirements for completeness and accuracy based on the field calibration records.	FTL / CH2M HILL	Step IIb	Internal
Documentation of Method QC Results	Establish that all required QC samples were run.	Data Validator / CH2M HILL	Step IIa	External
Documentation of Field QC Sample Results	Establish that all required QC samples were run.	PC / CH2M HILL	Step IIb	Internal
DoD ELAP Evaluation	Ensure that each laboratory is DoD ELAP Certified for the analyses they are to perform. Ensure evaluation timeframe does not expire.	PC / CH2M HILL	Step IIa	External
Analytical data for PAH and Metals all matrixes analyzed, e.g. surface soil, subsurface sediment, surface soil, groundwater, and/or tissue.	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria, which includes, but is not limited to holding time, sample preservation, blanks (field and method), field duplicates, lab duplicates, detection limits, surrogates recoveries, LCS/LCSD, MS/MSD, internal standard recovery, initial calibration criteria, and continuing calibration criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in <i>Region III Modifications to the National Functional Guidelines for Organic Data Review</i> (USEPA, 1994) and in <i>Region III Modifications to the Laboratory Data Validation Guidelines for Inorganic Data Review</i> (USEPA, 1993). National Functional Guidelines may be used for DV, and the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Data Validator / CH2M HILL	Step IIa and IIb	External
Analytical data for wet chemistry, AVS/SEM, and grain-size samples in all matrices analyzed.	Wet chemistry, AVS/SEM, and grain-size analytical data will not undergo third-party DV, but are subject to all other previously detailed data review protocols, excluding the 10% Level IV Validation.	N/A	Step IIa and IIb	N/A

Notes:

¹ Verification (Step I) is a completeness check that is performed before the data review process continues in order to determine whether the required information (complete data package) is available for further review.

Validation (Step IIa) is a review that the data generated is in compliance with analytical methods, procedures, and contracts.

Validation (Step IIb) is a comparison of generated data against MPC in the SAP (both sampling and analytical).

² Internal or external is in relation to the data generator.

SAP Worksheet #37—Usability Assessment

[\(UFP-QAPP Manual Section 5.2.3\)](#)

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

Nondetected site contaminants will be evaluated to make sure that project-required QLs in **Worksheet #15** were achieved. If PQLs were achieved and the verification and validation steps yielded acceptable data, then the data are considered usable. If PQLs were not achieved, then the reason will be investigated and documented, and the effect on data usability will be discussed.

During verification and validation steps, data may be qualified as estimated with the following qualifiers: J, UJ, K, L, or UL. These qualifiers represent minor QC deficiencies which will not affect the usability of the data. When major QC deficiencies are encountered, data will be qualified with an R and in most cases are not considered usable for project decisions.

J	Analyte present. Reported value is estimated and may or may not be accurate or precise
UJ	Analyte not detected. QL may be inaccurate or imprecise
K	Analyte present. Reported value is estimated and may be biased high. Actual value is expected to be lower
L	Analyte present. Reported value is estimated and may be biased low. Actual value is expected to be higher
UL	Analyte not detected. QL is probably higher
R	Rejected result. Result is not usable

Additional qualifiers that may be given by the validator include B, N, NJ, and U:

B	Not detected more than 5 times than that in an associated blank (10 times for common laboratory contaminants in VOCs)
N	Tentative ID. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts
NJ	Qualitative ID questionable because of poor resolution. Presumptively present at approximate quantity.
U	Not Detected

- For statistical comparison, nondetect values will be represented by a concentration equal to one-half the sample RL. For duplicate sample results, the greater of the values will be used for project decisions.
- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hard copy data and qualifiers to the EDD. Once the data have been uploaded into the electronic database, another check will be performed to be sure all results were loaded accurately.
- Field and laboratory precision will be assessed as RPD between the two results. Field precision will be assessed using the RPD between the MS/MSD and between the field duplicate samples, while laboratory precision will be assessed using the RPD between the LCS/LCSD samples.
- Deviations from the SAP will be reviewed to assess whether CA is warranted and to assess impacts to achievement of project objectives.

SAP Worksheet #37—Usability Assessment (continued)

- To assess whether a sufficient quantity of acceptable data are available for decision making, the data will be compared to a 95% completeness goal following validation. Completeness will be calculated for the entire dataset as a percentage of available results (i.e. results which are not R-qualified) relative to the total number of results; results for field blanks and laboratory QC samples will not be considered in this calculation.

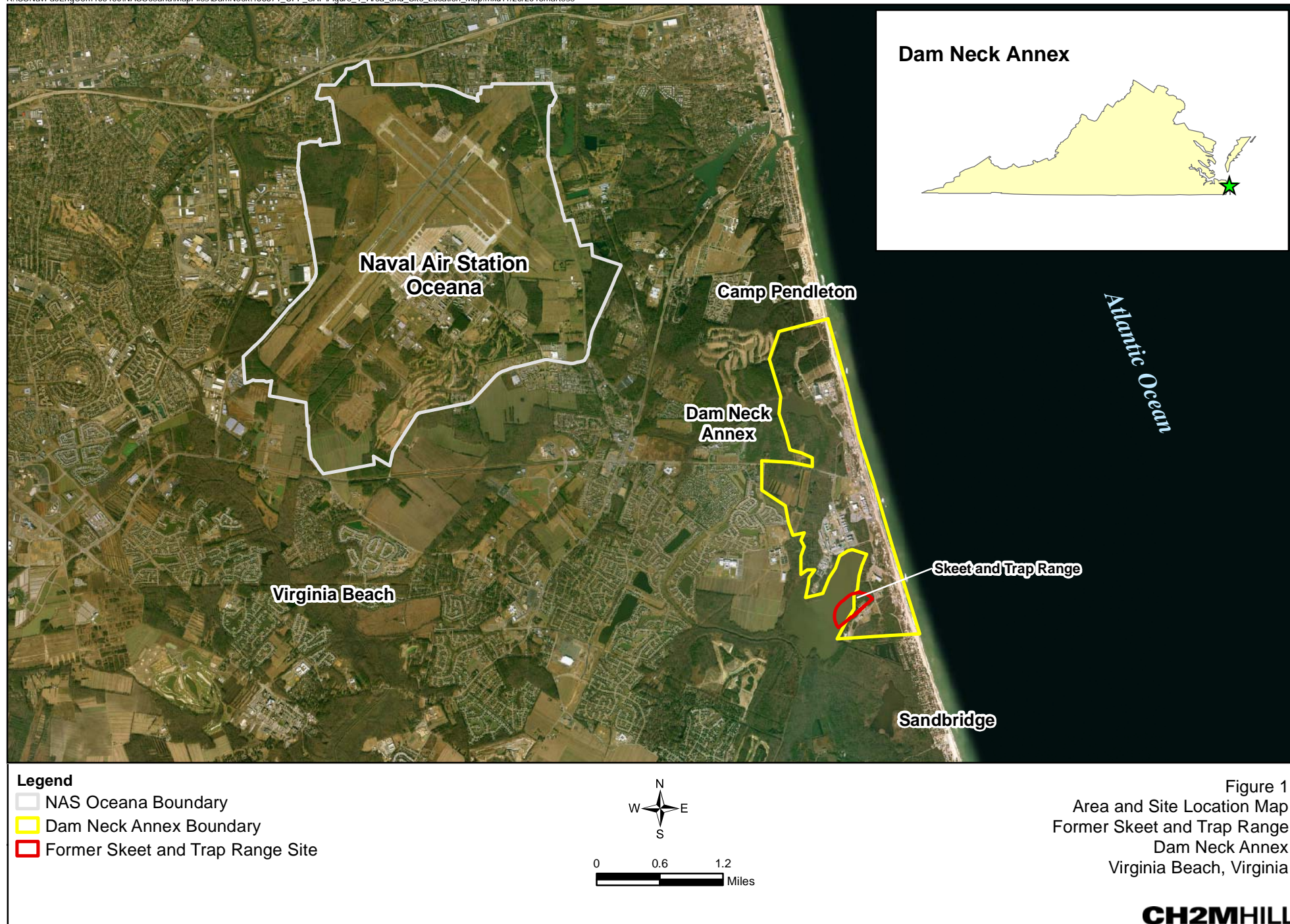
Identify the personnel responsible for performing the usability assessment:

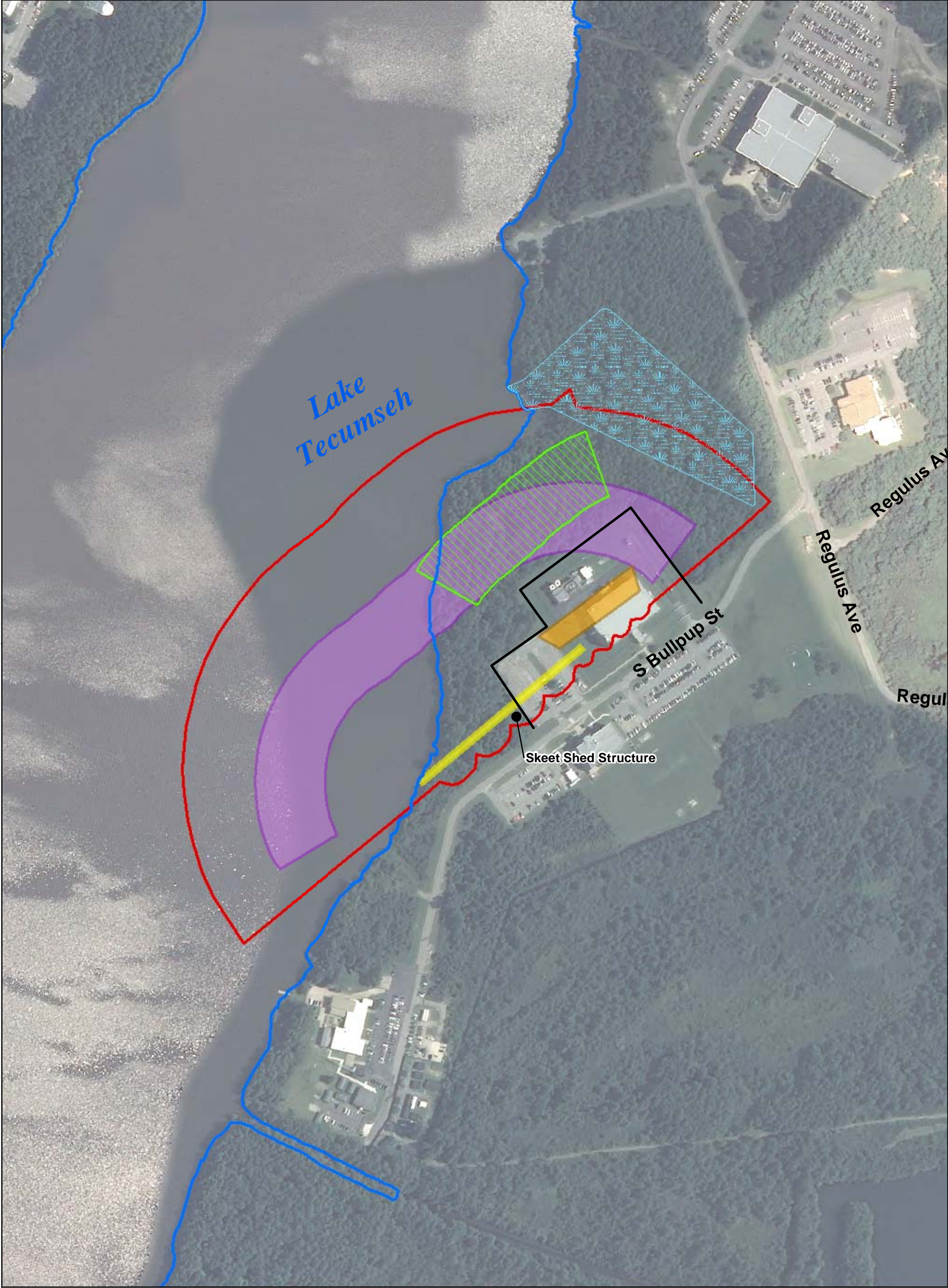
- The PM, PC, and other team members will be responsible for compiling the data. The data will then be presented to the Partnering Team which, as a whole, will evaluate the data usability according to project objectives.

References

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- USEPA. 2002. *United States Environmental Protection Agency (USEPA) Guidance for Quality Assurance Project Plans, EPA QA/G-5*.
- USEPA. 2005. *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)*.
- USEPA. 2011. *Assessment of methods for estimating risk to birds from ingestion of contaminated grit particles*. EPA/600/R-11/023, ERASC-016F. February.

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- Legend**
- Fence and Parking Lot border
 - Approximate Location of Standing Water
 - Shoreline
 - ▨ Area of Presumed Maximum Trap Shotfall
 - ▨ Area of Presumed Maximum Trap Target Debris
 - ▨ Area of Presumed Maximum Skeet Shotfall
 - ▨ Area of Presumed Maximum Skeet Target Debris
 - MRP Site



0 200 400 600
Feet

Figure 2
Site Map
Former Skeet and Trap Range
Dam Neck Annex
Virginia Beach, Virginia

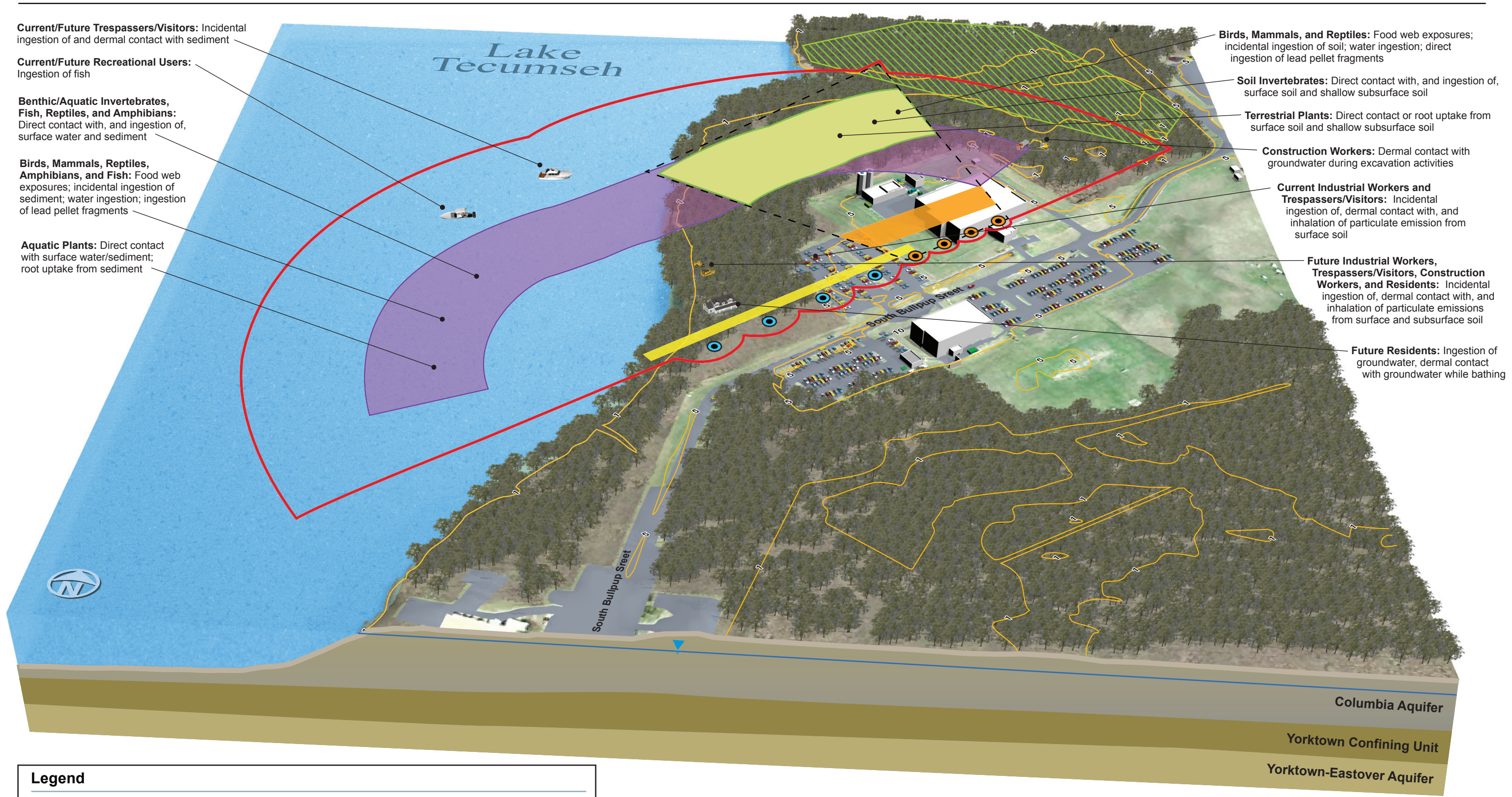


Figure 3
Conceptual Site Model
 Former Skeet and Trap Range
 Remedial Investigation UFP-SAP
 Dam Neck Annex - NAS Oceana
 Virginia Beach, Virginia

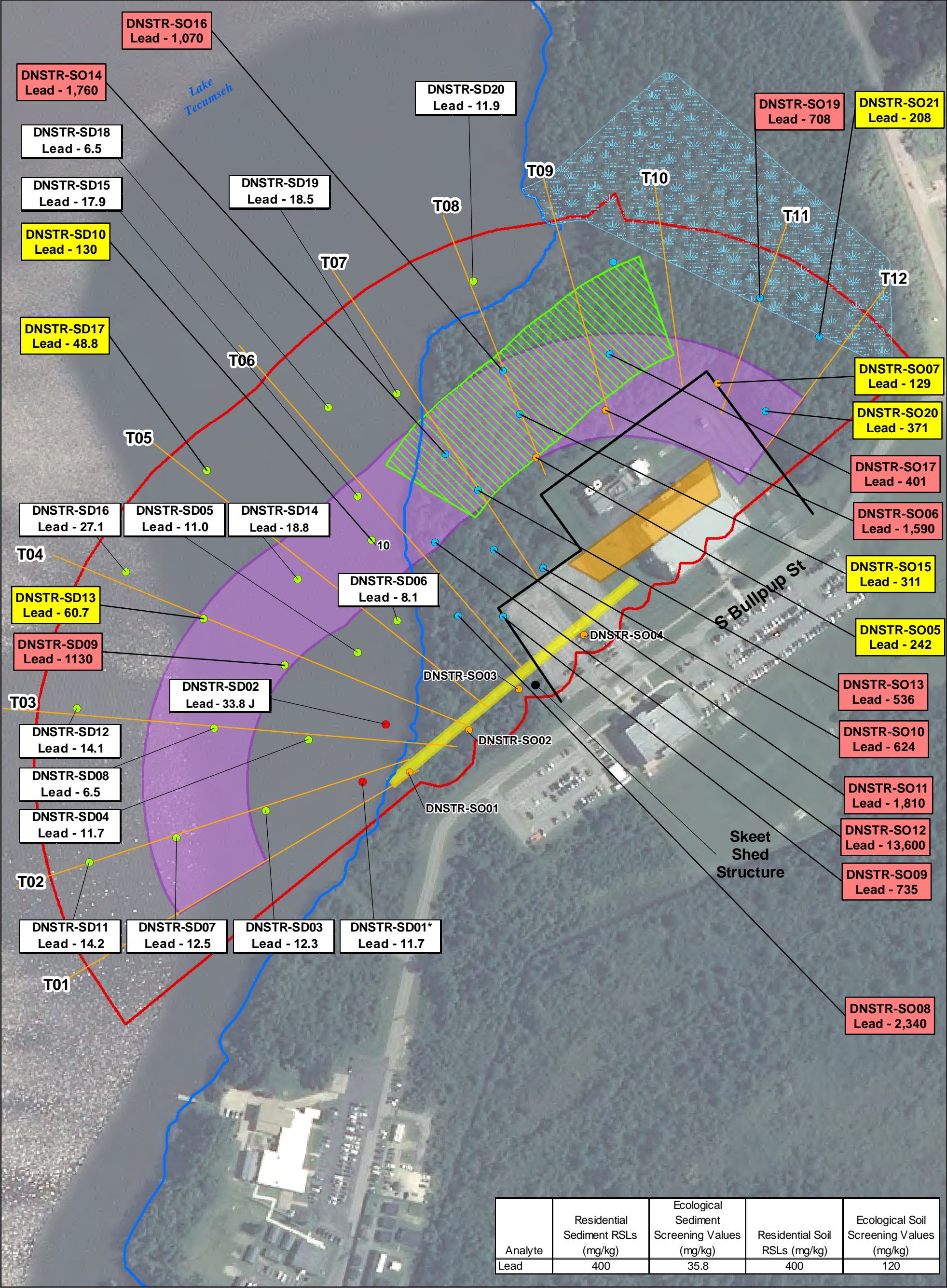
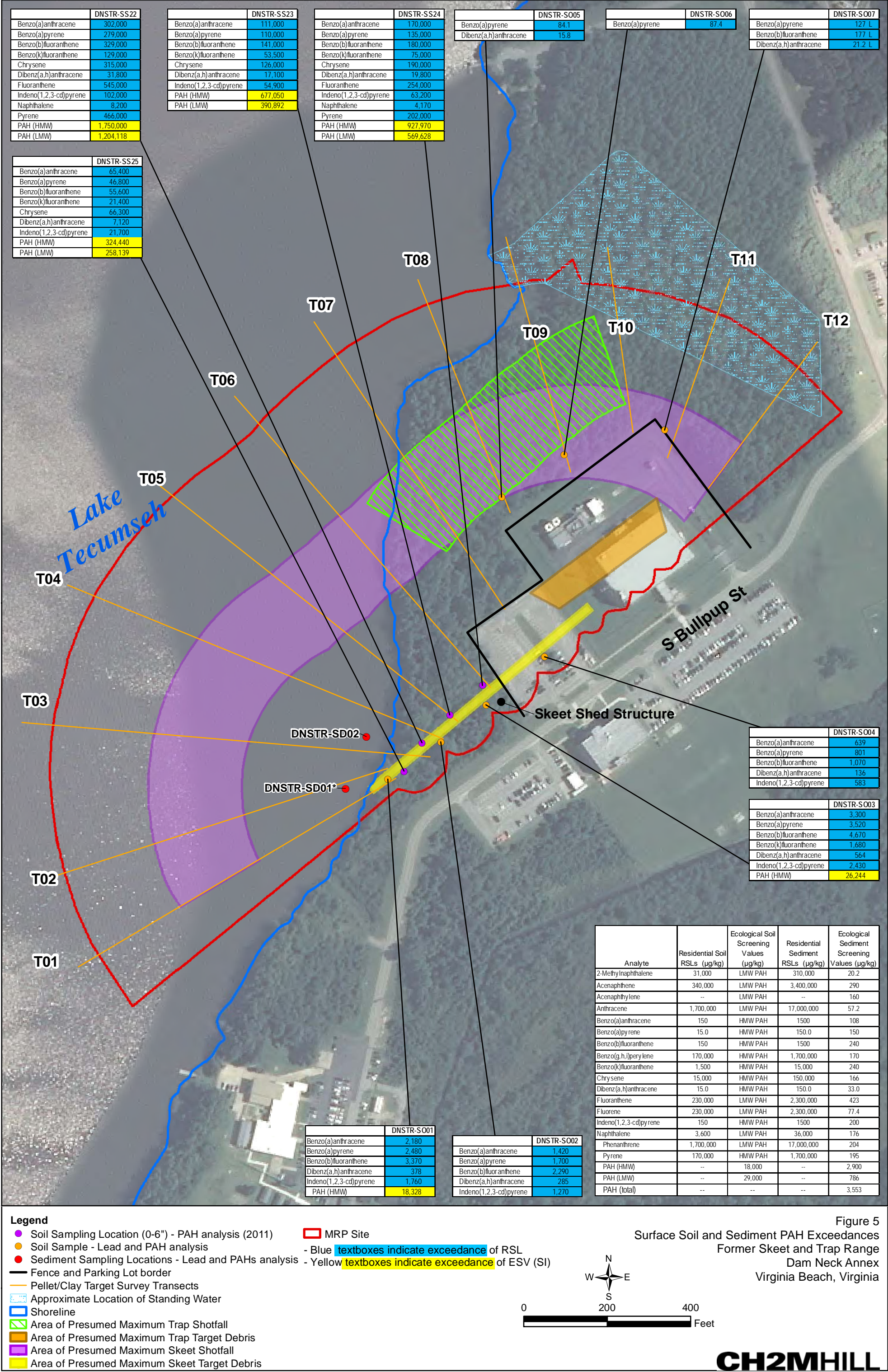


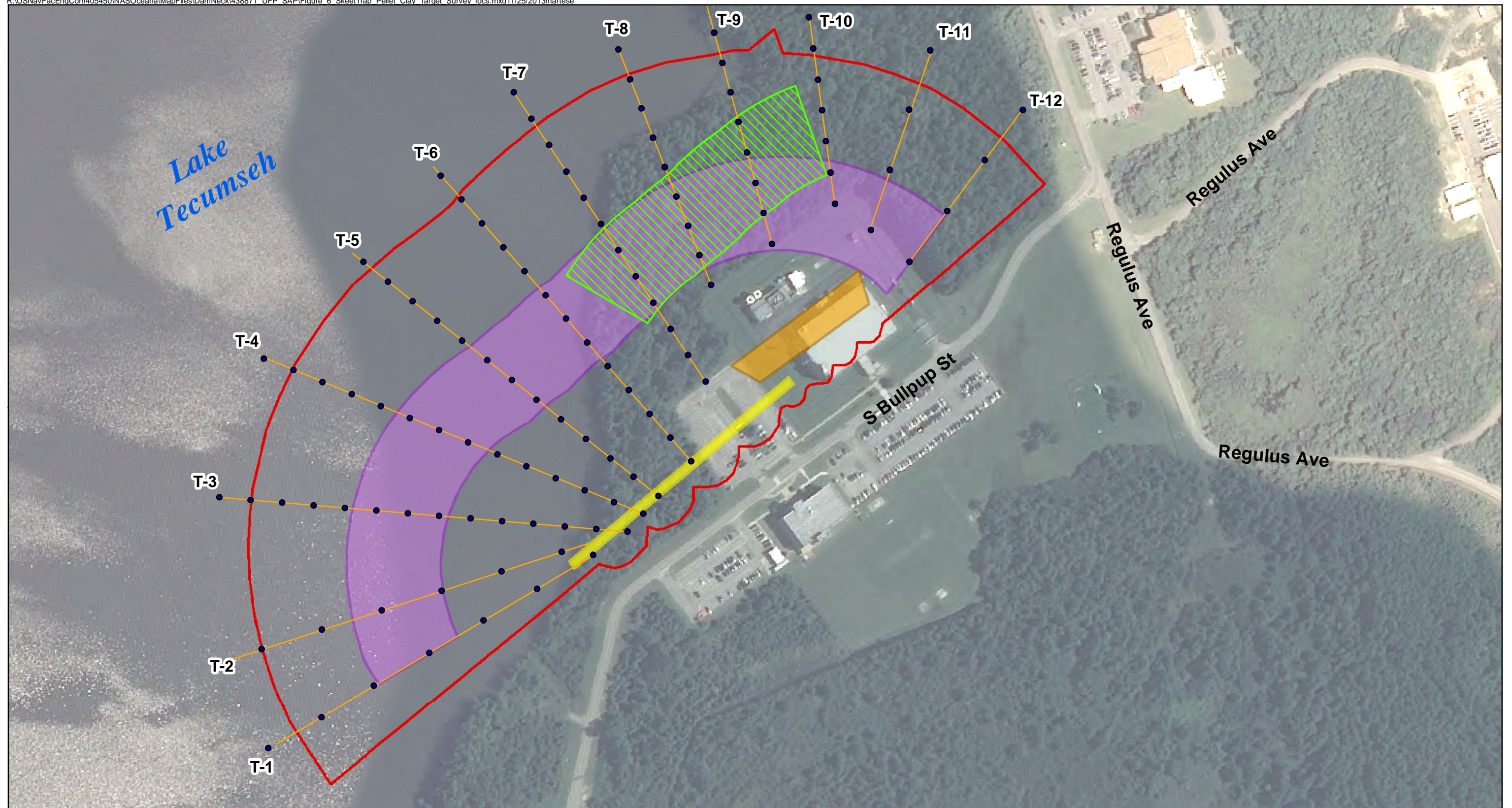
Figure 4
Surface Soil and Sediment Lead Exceedances
Former Skeet and Trap Range
Dam Neck Annex
Virginia Beach, Virginia



0 200 400
Feet

CH2MHILL





Legend

- Pellet/Clay Survey Locations
- Pellet/Clay Survey Transects
- ▨ Estimated Maximum Trap Shotfall
- Estimated Maximum Skeet Shotfall
- Estimated Maximum Trap Clay Target Debris
- Estimated Maximum Skeet Clay Target Debris

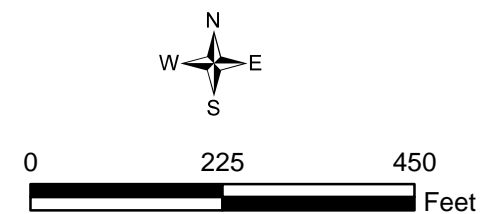
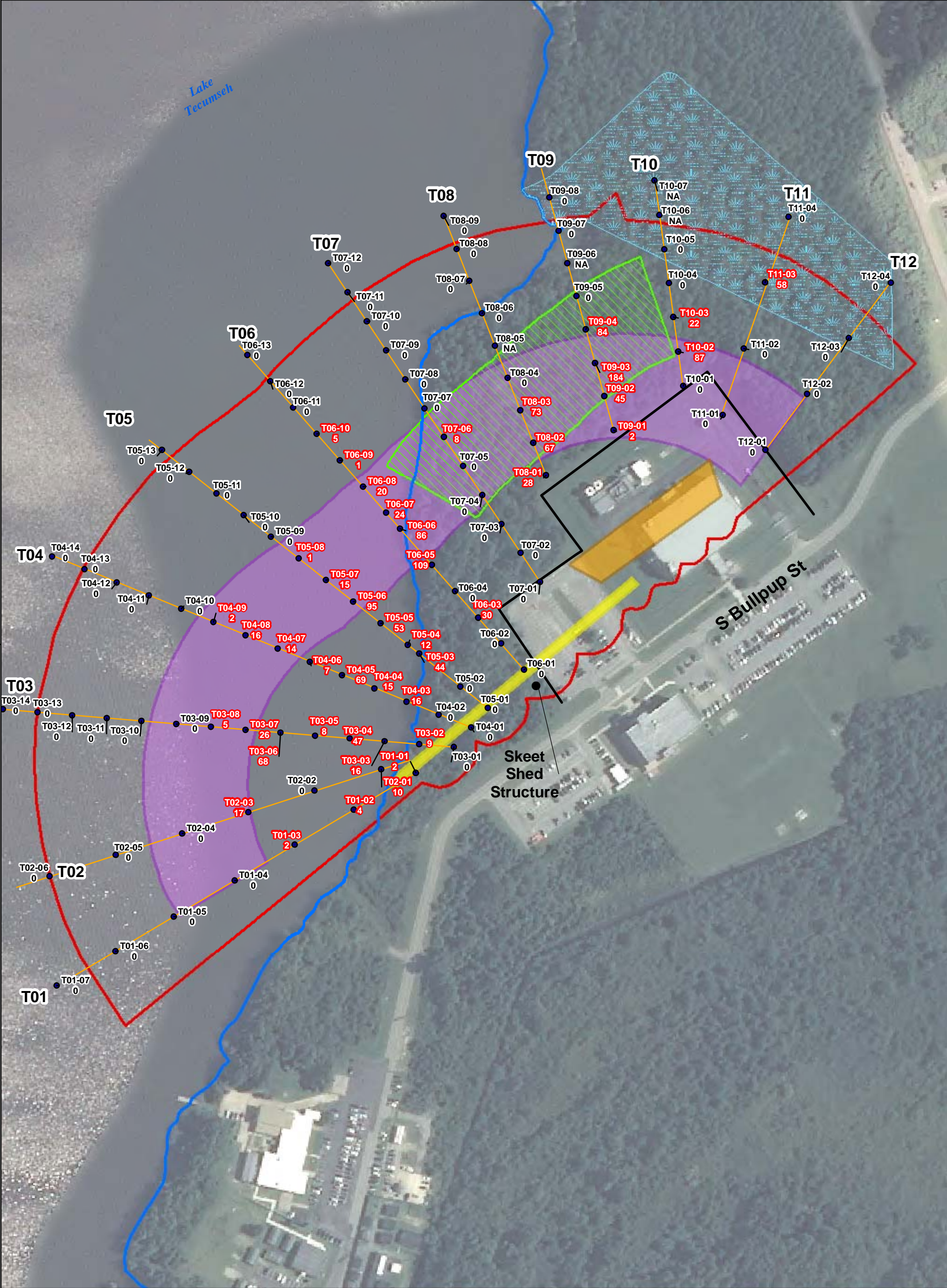


Figure 6
Pellet/Clay Target Survey Locations
Former Skeet and Trap Ranges
Dam Neck Annex
Virginia Beach, Virginia



- Legend**
- Pellet/Clay Target Survey Locations (2013)
 - Fence and Parking Lot border
 - Pellet/Clay Target Survey Transects
 - Approximate Location of Standing Water
 - Shoreline
 - Area of Presumed Maximum Trap Shotfall
 - Area of Presumed Maximum Trap Target Debris
 - Area of Presumed Maximum Skeet Shotfall
 - Area of Presumed Maximum Skeet Target Debris
 - MRP Site

- Pellet/Clay Target Survey Location Values Represent
Total Lead Pellets Found
- Red labels are pellet counts greater than 0
- NA = Not Accessible

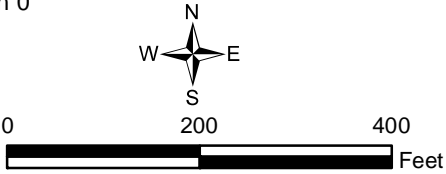
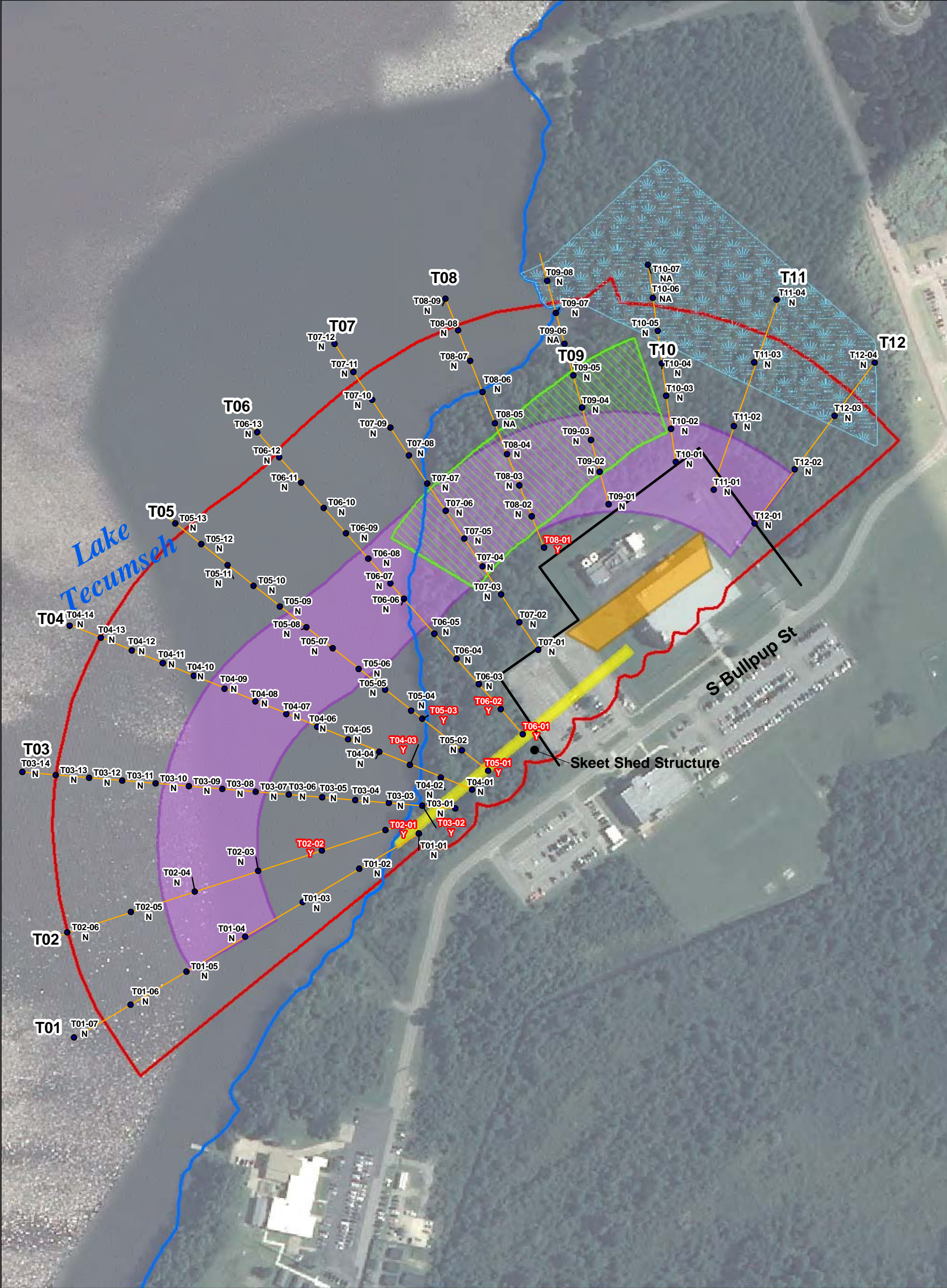


Figure 7
Surface Soil and Sediment
Survey Count Results - Lead Pellets
Former Skeet and Trap Range
Dam Neck Annex
Virginia Beach, Virginia



- Legend**
- Pellet/Clay Target Survey Locations (2013)
 - Fence and Parking Lot border
 - Pellet/Clay Target Survey Transects
 - Approximate Location of Standing Water
 - Shoreline
 - MRP Site
 - Area of Presumed Maximum Trap Shotfall
 - Area of Presumed Maximum Trap Target Debris
 - Area of Presumed Maximum Skeet Shotfall
 - Area of Presumed Maximum Skeet Target Debris

- Pellet/Clay Target Survey Location Values Represent Total Clay Target Fragments Present (Y) or Absent (N)
- Red labels are Clay Target Debris equal to Yes
- NA = Not Accessible

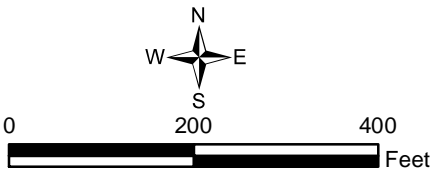
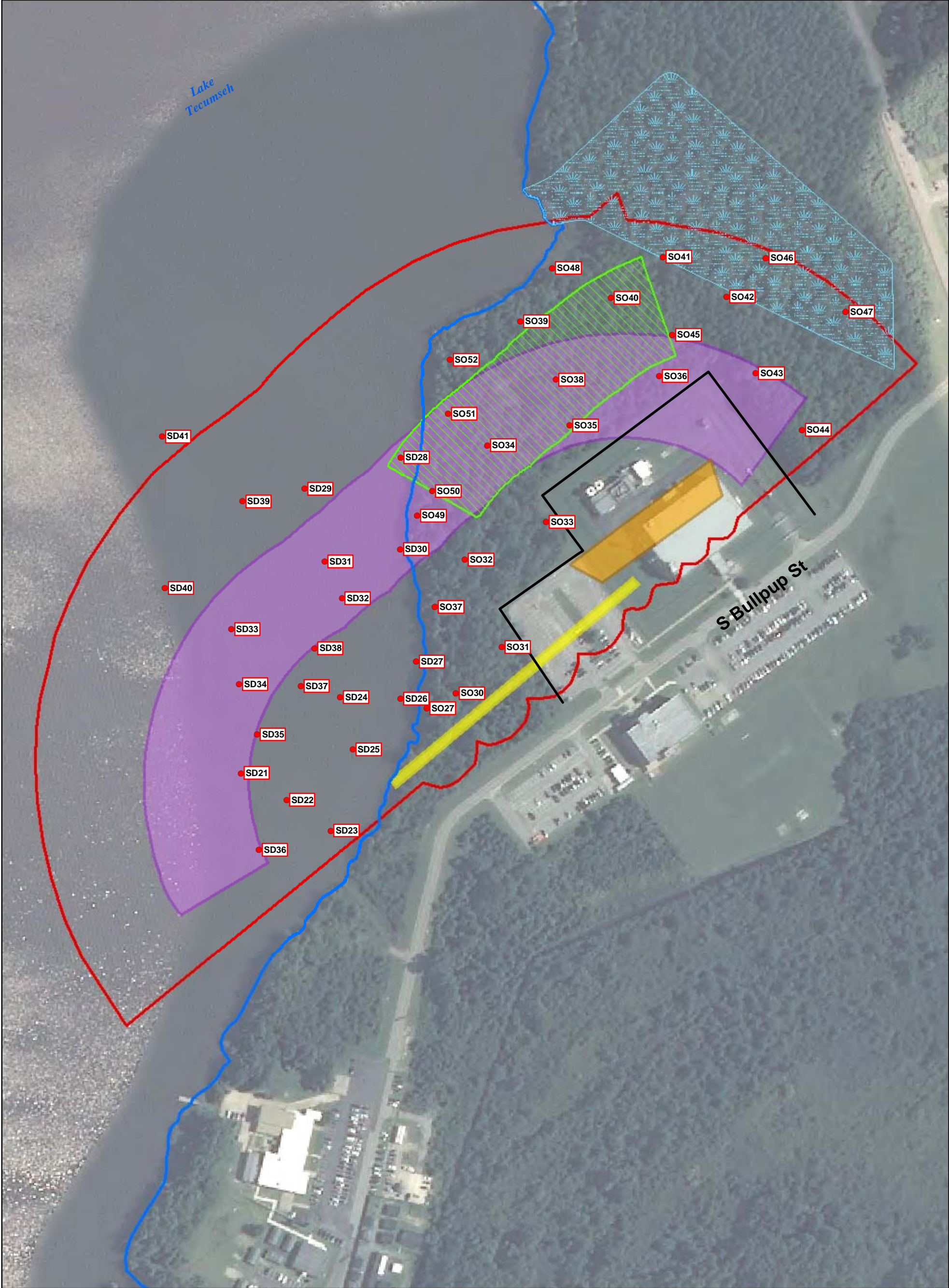


Figure 8
Surface Soil and Sediment
Survey Count Results - Clay Target Debris
Former Skeet and Trap Range
Dam Neck Annex
Virginia Beach, Virginia



- Legend**
- Proposed Sample Locations - Lead Analysis
 - Fence and Parking Lot border
 - Approximate Location of Standing Water
 - Shoreline
 - Area of Presumed Maximum Trap Shotfall
 - Area of Presumed Maximum Trap Target Debris
 - Area of Presumed Maximum Skeet Shotfall
 - Area of Presumed Maximum Skeet Target Debris
 - MRP Site

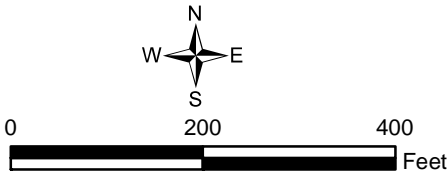
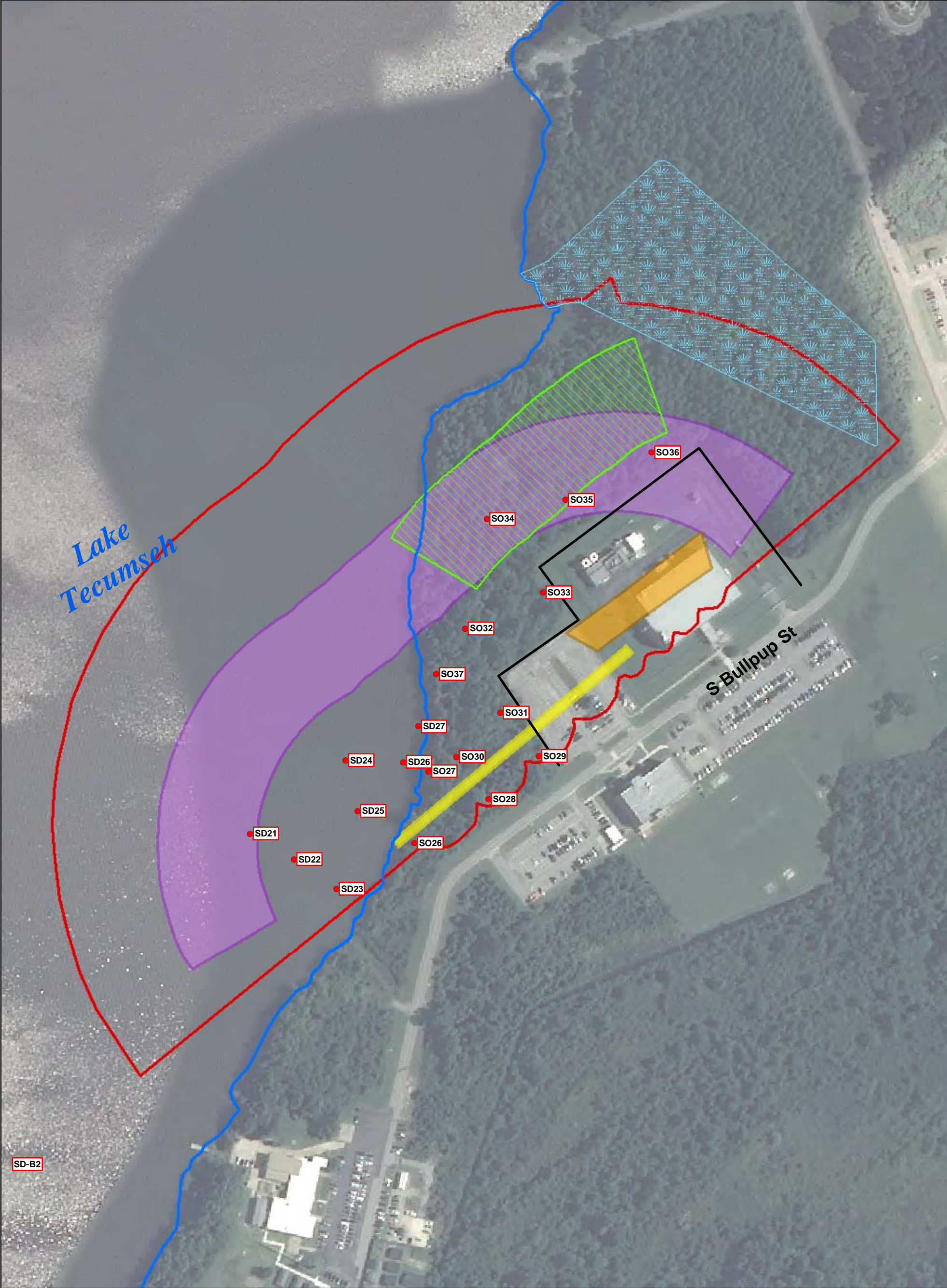


Figure 9
Proposed Lead Soil/Sediment Sample Locations
Former Skeet and Trap Range
Dam Neck Annex
Virginia Beach, Virginia



- Legend**
- Proposed Sample Locations - PAH Analysis
 - Fence and Parking Lot border
 - Approximate Location of Standing Water
 - Shoreline
 - ▨ Area of Presumed Maximum Trap Shotfall
 - ▨ Area of Presumed Maximum Trap Target Debris
 - ▨ Area of Presumed Maximum Skeet Shotfall
 - ▨ Area of Presumed Maximum Skeet Target Debris
 - MRP Site

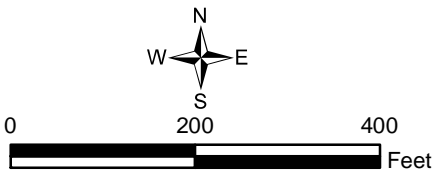


Figure 10
Proposed PAH Soil/Sediment Sample Locations
Former Skeet and Trap Range
Dam Neck Annex
Virginia Beach, Virginia

Appendix A

Field Standard Operating Procedures

Equipment Blank and Field Blank Preparation

I. Purpose

To prepare blanks to determine whether decontamination procedures are adequate and whether any cross-contamination is occurring during sampling due to contaminated air and dust.

II. Scope

The general protocols for preparing the blanks are outlined. The actual equipment to be rinsed will depend on the requirements of the specific sampling procedure.

III. Equipment and Materials

- Blank liquid (use ASTM Type II or lab grade water)
- Millipore™ deionized water
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

IV. Procedures and Guidelines

- A. Decontaminate all sampling equipment that has come in contact with sample according to SOP *Decontamination of Personnel and Equipment*.
- B. To collect an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

For non-volatiles analyses, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces which contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles.

Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

- C. When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling VOCs. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decon. When decon is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.
- D. To collect a field blank, slowly pour ASTM Type II or lab grade water directly into sample containers.
- E. Document and ship samples in accordance with the procedures for other samples.
- F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

- Wear gloves.
- Do not use any non-decontaminated equipment to prepare blank.
- Use ASTM-Type II or lab grade water.

Chain-of-Custody

I Purpose

The purpose of this SOP is to provide information on chain-of-custody procedures to be used under the CLEAN Program.

II Scope

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities (except wellhead samples taken for measurement of field parameters). Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. This procedure identifies the necessary custody records and describes their completion. This procedure does not take precedence over region specific or site-specific requirements for chain-of-custody.

III Definitions

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. One copy of the form must be retained in the project file.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under one's custody if:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and then he/she locked it up to prevent tampering.
- It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

IV. Procedures

The term “chain-of-custody” refers to procedures which ensure that evidence presented in a court of law is valid. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom, as well as providing security for the evidence as it is moved and/or passed from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain-of-possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When *in situ* measurements are made, the data are recorded directly in bound logbooks or other field data records with identifying information.

Information which shall be recorded in the field logbook, when in-situ measurements or samples for laboratory analysis are collected, includes:

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,
- Date and time of sample collection and/or measurement,
- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

Sample Label

Samples, other than for *in situ* measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling and Analysis Plan. Each sample container is identified by a sample label (see Attachment A). Sample labels are provided, along with sample containers, by the analytical laboratory. The information recorded on the sample label includes:

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 08/21/12).

- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site). The field team should always follow the sample ID system prepared by the project EIS and reviewed by the Project Manager.

Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed.

Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.
- A Chain-of-Custody Record will be prepared for each individual cooler shipped and will include *only* the samples contained within that particular cooler. The Chain-of-Custody Record for that cooler will then be sealed in a zip-log bag and placed in the cooler prior to sealing. This ensures that the laboratory properly attributes trip blanks with the correct cooler and allows for easier tracking should a cooler become lost during transit.
- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.
- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once downloaded to the server or developed, the electronic files or photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographic prints will be stored in the project files. To identify

sample locations in photographs, an easily read sign with the appropriate sample location number should be included.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. **A Chain-of-Custody Record Form must be completed for each cooler and should include only the samples contained within that cooler.** A Chain-of-Custody Record Form example is shown in Attachment B. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as given below:

- Enter header information (CTO number, samplers, and project name).
- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).
- Sign, date, and enter the time under “Relinquished by” entry.
- Have the person receiving the sample sign the “Received by” entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).
- If a carrier is used, enter the airbill number under “Remarks,” in the bottom right corner;
- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.
- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.
- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.
- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

V Quality Assurance Records

Once samples have been packaged and shipped, the Chain-of-Custody copy and airbill receipt become part of the quality assurance record.


VI Attachments

- A. Sample Label
- B. Chain of Custody Form
- C. Custody Seal

VII References

USEPA. *User's Guide to the Contract Laboratory Program*. Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

Attachment A
Example Sample Label

	 Quality Analytical Laboratories, Inc. 2567 Fairlane Drive Montgomery, Alabama 36116 PH. (334)271-2440
	Client _____
	Sample No. _____
	Location _____
	Analysis _____
	Preservative HCL _____
	Date _____ By _____

CEIMIC CORPORATION 10 Dean Knauss Drive, Narragansett, R.I. 02882 • (401) 782-6900	
SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE
SAMPLE TYPE	
<input type="checkbox"/> Grab <input type="checkbox"/> Composite <input type="checkbox"/> Other _____	
COLLECTED BY:	

Attachment B
Example Chain-of-Custody Record

Instructions and Agreement Provisions on Reverse Side

Attachment C
Example Custody Seal



CUSTODY SEAL

Date

Signature

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

The purpose of this guideline is to provide methods for the decontamination of drilling rigs, downhole drilling tools, and water-level measurement equipment. Personnel decontamination procedures are not addressed in this SOP; refer to the site safety plan and SOP *Decontamination of Personnel and Equipment*. Sample bottles will not be field decontaminated; instead they will be purchased with certification of laboratory sterilization.

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Liquinox®
- Buckets
- Brushes
- Isopropanol, pesticide grade
- Personal Protective Equipment as specified by the Health and Safety Plan
- ASTM-Type II grade water or Lab Grade DI Water
- Aluminum foil

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

Before the onset of drilling, after each borehole, before drilling through permanent isolation casing, and before leaving the site, heavy equipment and machinery will be decontaminated by steam cleaning at a designated area. The steam-cleaning area will be designed to contain decontamination wastes and waste waters and can be an HDPE-lined, bermed pad. A pumping system will be used to convey decontaminated water from the pad to drums.

Surface casings may be steam cleaned in the field if they are exposed to contamination at the site prior to use.

B. Downhole Drilling Tools

Downhole tools will be steam cleaned before the onset of drilling, prior to drilling through permanent isolation casing, between boreholes, and prior to leaving the site. This will include, but is not limited to, rods, split spoons or similar samplers, coring equipment, augers, and casing.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for physical characterization, the sampler shall be cleaned by scrubbing with a detergent solution followed by a potable water rinse.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for chemical analysis, the sampler shall be decontaminated following the procedures outlined in the following subsection.

C. Field Analytical Equipment

1. Water Level Indicators

Water level indicators that consist of a probe that comes into contact with the groundwater must be decontaminated using the following steps:

- a. Rinse with tap water
- b. Rinse with de-ionized water
- c. Solvent rinse with isopropanol
- d. Rinse with de-ionized water

2. Probes

Probes, for example, pH or specific ion electrodes, geophysical probes, or thermometers that would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise. For probes that make no direct contact, for example, OVM equipment, the probe will be wiped with clean paper-towels or cloth wetted with isopropanol.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- The effectiveness of field cleaning procedures may be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis.

Disposal of Waste Fluids and Solids

I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Paint Pens
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rollofs
- Tools for securing drum lids
- Paint Pens
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rollofs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will

be labeled as they are filled in the field and labels indicating that the contents are pending analysis affixed.

The drum contents will be sampled to determine the disposal requirements of the drilling wastes. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums (check with disposal facility to determine sample frequency) containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rollofs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Date that accumulation began
- Date that accumulation ended
- Generator Contact Information
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C if the results indicate hazardous waste or labeled as non-hazardous if applicable.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the amount of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to the drum storage area by the drilling services subcontractor. Drums should be stored on pallets on plastic sheeting with a short berm wall (hay bales or 2 x 4 planks or equivalent) to capture small spills.

Waste solid materials that contain hazardous constituents will be disposed of at an offsite location in a manner consistent with applicable solid waste, hazardous waste, and water quality regulations. Transport and disposal will be performed by a commercial firm under subcontract.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. However, prior to disposal to the sanitary sewer system, approval and contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- Check that representative samples of the containerized materials are obtained.
- Be sure that all state and federal regulations are considered when classifying waste for disposal.

Direct-Push Soil Sample Collection

I. Purpose

To provide a general guideline for the collection of soil samples using direct-push (e.g., Geoprobe®) sampling methods.

II. Scope

Standard direct-push (e.g., Geoprobe®) soil sampling methods.

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer
- Sampling rods
- Sampling tubes and acetate liners
- Pre-cleaned sample containers and stainless-steel sampling implements
- Personal Protective Equipment as specified by the Health and Safety Plan

IV. Procedures and Guidelines

1. Decontaminate sampling tubes and other non-dedicated downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment*.
2. Drive sampling tube to the desired sampling depth using the truck-mounted hydraulic percussion hammer. If soil above the desired depth is not to be sampled, first drive the lead rod, without a sampling tube, to the top of the desired depth.
3. Remove the rods and sampling tube from the borehole and remove the sampling tube from the lead rod.
4. Cut open the acetate liner using a specific knife designed to slice the acetate liners (see below).



5. Fill all sample containers, beginning with the containers for VOC analysis, using a decontaminated or dedicated sampling implement. For the VOC samples, place the sample into a pre-preserved VOA vial or direct sample container such as an **En Core®** or **Terra Core®** sampler and seal the cap tightly. Ideally, the operation should be completed in one minute. Label the vials and place on ice for shipment to the laboratory.
6. Decontaminate all non-dedicated downhole equipment (rods, sampling tubes, etc.) in accordance with SOP *Decontamination of Personnel and Equipment*.
7. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required.

V. Key Checks and Items

1. Verify that the hydraulic percussion hammer is clean and in proper working order.
2. Ensure that the direct-push operator thoroughly completes the decontamination process between sampling locations.
3. Verify that the borehole made during sampling activities has been properly backfilled.

Sampling Contents of Tanks and Drums

I. Scope and Application

This procedure provides an overview approach and guidelines for the routine sampling of drums and tanks. Its purpose is to describe standard procedures and precautions which are applied in sampling drums and tanks. Procedures for opening drums with the individual instruments are included in Attachment D.

The samples obtained may be used to obtain physical chemical or radiological data. The resulting data may be qualitative or quantitative in nature, and are appropriate for use in preliminary surveys as well as confirmatory sampling.

II. Summary of Methods

Drums are generally sampled by means of sampling tubes such as glass sample tubes or COLIWASA samplers. In either case, the sampling tube is manually inserted into the waste material. A sample of the drum contents is withdrawn by the sampling device. Should a drum contain bottom sludge, a glass tube will be used to retrieve a sample of this as well.

Storage tank and tank trailers, because of their greater depths, require sampling devices that can be lowered from the top, filled at a particular depth, then withdrawn. Such devices are a COLIWASA, a Kemmerer depth sampler, or a Bacon Bomb. Where samples of bottom sludge are desired, a gravity corer can be utilized. This heavy tube with a tapered nose piece will penetrate the sludge as it free falls through the tank.

III. Comments

The sampling of tanks, containers, and drums present unique problems not associated with environmental samples. Containers of this sort are generally closed except for small access ports, manways, or hatches on the larger vessels, or taps and bungs on smaller drums. The physical size, shape, construction material, and location of access limit the types of equipment and methods of collection that can be used.

When liquids are contained in sealed vessels, gas vapor pressure can build up, sludges can settle out, and density layerings (stratification) can develop. Bulging drums may be under pressure and extreme caution should be exercised. The potential exists for explosive reactions or the release of noxious gases when containers are opened. All vessels should be opened with extreme caution. Check the HSP for the level of personnel protection to be worn. A preliminary sampling of any headspace gases is warranted. As a minimum, a preliminary check with an

explosimeter and an organic vapor analyzer may be of aid in selecting a sampling method.

In most cases it is impossible to observe the contents of these sealed or partially sealed vessels. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the vessel.

IV. Required Equipment and Apparatus

- A. **Health and safety equipment/materials:** As listed in the site safety plan.
- B. **Sampling equipment:** COLIWASA, glass sample tubes, Kemmerer depth sampler, Bacon Bomb, gravity corer.
- C. **Tools:** Rubber mallet, bung wrench, speed wrench with socket, etc., (all non-sparking), paint marker.
- D. **Heavy equipment:** Backhoe equipped with explosion shield, drum grappler, and 3-foot copper-beryllium (non-sparking) spike with 6-inch collar (to puncture top of drums for sampling, if necessary).
- E. **Sample Containers:** As specified in the field sampling plan.

V. Procedures

A. Drums

NOTE: DO NOT open more than one drum at a time. Each drum must be handled and sampled as a separate entity to reduce vapors in the sampling area.

1. Drums will be sampled on an area-by-area basis. Drums will be sampled after they have been placed in overpack drums but before they are transferred from the excavation to the onsite storage area.
2. Record, in logbook, all pertinent information from visual inspection of drum (e.g., physical condition, leaks, bulges, and labels). Label each drum with a unique identifying number.
3. If possible, stage drums for easy access.
4. If necessary, attach ground strap to drums and grounding point.
5. Remove any standing material (water, etc.) from container top.
6. Using non-sparking tools, carefully remove the bung or lid while monitoring air quality with appropriate instruments. If necessary (and as a last resort), the non-sparking spike affixed to the backhoe can also be used to puncture the drum for sampling. See Attachment D for method of drum opening. Record air-quality monitoring results.

7. When sampling a previously sealed vessel, a check should be made for the presence of bottom sludge. This is accomplished by measuring the depth to apparent bottom, then comparing it to the known interior depth.
8. Agitation to disrupt the layers and rehomogenize the sample is physically difficult and almost always undesirable. If the vessel is greater than 3 feet in depth (say, a 55-gallon drum), the appropriate sampling method is to slowly lower the sampling device (i.e., suction line of peristaltic pump, glass tube) in known increments of length. Discrete samples can be collected from various depths, then combined or analyzed separately. If the depth of the vessel is greater than the lift capacity of the pump, an at-depth water sampler, such as the Kemmerer or Bacon Bomb type, may be required.
9. Extract a representative sample from the drum using a glass rod, COLIWASA, Bacon Bomb, Kemmerer bottle, or gravity corer (See Attachments). Ensure that the entire depth of material is penetrated. Depending on the size of the opening of the drum, three to four takes should be collected from random locations across the drum surface, to ensure a representative sample. Any observed stratification must be recorded in logbook, including number and thickness of the layers and a conceptualized sketch.
10. Record a visual description of the sample (e.g., liquid, solid, color, viscosity, and percent layers).
11. When possible, sampling equipment (like glass tubes) should be expendable and be left inside the drum for disposal with drum contents, once sampling is completed.
12. Place lid, bung, cap, etc., back in place on drum. Tighten hand tight. If necessary, the sampling port can be sealed using a cork.
13. Wipe up spilled material with lab wipes. Wipe off sample containers.
14. Mark the drum with a unique sample identification number and date using a paint marker.
15. Samples will be handled as high hazard samples. Samples will be placed in containers defined according to the analytical needs, wiped clean, and then packed in paint cans for shipping. Packaging, labeling, and preparation for shipment procedures will follow procedures as specified in the field sampling plan.

B. Underground Storage Tanks

1. A sampling team of at least two people is required for sampling—one will collect samples, the other will relay required equipment and implements.

2. Sampling team will locate a sampling port on the tank. Personnel should be wearing appropriate protective clothing at this time and carrying sampling gear.
3. Do not attempt to climb down into tank. Sampling MUST BE accomplished from the top.
4. Collect a sample from the upper, middle, and lower section of the tank contents with one of the recommended sampling devices.
5. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.
6. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

C. Tank Trailers or Above-Ground Storage Tanks

1. A sampling team of two is required. One will collect samples, the other will relay required equipment and implements.
2. Samples will be collected through the manhole (hatch) on top of the tanker or the fill port. Do not open valves at the bottom. Before opening the hatch, check for a pressure gauge or release valve. Open the release valve slowly to bring the tank to atmospheric pressure.
3. If tank pressure is too great, or venting releases large amounts of toxic gas, discontinue venting and sampling immediately. Measure vented gas with organic vapor analyzer and explosimeter.
4. If no release valve exists, slowly loosen hatch cover bolts to relieve pressure in the tank. (Again, stop if pressure is too great.)
5. Once pressure in tank has been relieved, open the hatch and withdraw sample using one of the recommended sampling devices.
6. Sample each trailer compartment.
7. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.
8. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

D. Refer to Attachment B for procedures for sampling with appropriate devices as follows:

Drum

Glass tube — Procedure 1

COLIWASA – Procedure 2

Storage Tank and Tank Trailer

COLIWASA – Procedure 2

Bacon Bomb – Procedure 3

Gravity Corer – Procedure 4
(for bottom sludge)

VI. Contamination Control

Sampling tools, instruments, and equipment will be protected from sources of contamination prior to use and decontaminated after use as specified in SOP *Decontamination of Personnel and Equipment*. Liquids and materials from decontamination operations will be handled in accordance with the waste management plan. Sample containers will be protected from sources of contamination. Sampling personnel shall wear chemical resistant gloves when handling any samples. Gloves will be decontaminated or disposed of between samples.

VIII. Attachments

- A. Collection of Liquid-Containerized Wastes Using Glass Tubes
- B. Sampling Containerized Wastes Using the Composite Liquid Waste Sample (COLIWASA)
- C. Sampling Containerized Wastes Using the Bacon Bomb Sampler
- D. Gravity Corer for sampling Sludges in Large Containers
- E. Construction of a Typical COLIWASA
- F. Drum Opening Techniques and Equipment

IX. References

A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, U.S. Environmental Protection Agency, Washington, D.C., 1987.

Data Quality Objectives for Remedial Activities - Development Process, EPA/540/G-87/003, U.S. Environmental Protection Agency, Washington, D.C., 1987.

Annual Book of ASTM Standards, Standard Recommended Practices for Sampling Industrial Chemicals, ASTM-E-300, 1986.

Test Method for Evaluating Solid Waste, SW-846, Volume II, Field Methods, Second Edition, U.S. Environmental Protection Agency, Washington, D.C., 1982.

U.S. Environmental Protection Agency, *Characterization of Hazardous Waste Sites – A Method Manual: Volume II, Available Sampling Methods*, USEPA Environmental Monitoring Systems Laboratory, Las Vegas, EPA-600/4-84-076, December, 1984.

Environmental Surveillance Procedures, Quality Control Program, Martin Marietta Energy Systems, ESH/Sub/87-21706/1, Oak Ridge, TN, September 1988.

X. Field Checklist

_____ Sampling Instruments	_____ Labels
_____ Tools	_____ Sampling and Analysis Plan
_____ Rubber Mallet	_____ Health and Safety Plan
_____ Logbook	_____ Decontamination Equipment
_____ Safety Glasses or Monogoggles	_____ Lab Wipes
_____ Safety Shoes	_____ Lab Spatulas or Stainless Steel Spoons
_____ Ice/Cooler, as required	_____ Chemical Preservatives, as required
_____ Custody Seals, as required	_____ Appropriate Containers for Waste and Equipment
_____ Chain-of-Custody Forms	_____ Duct Tape
_____ Drum Labels, as required	_____ Plastic Sheetting
_____ Paint Marker, if drum sampling	
_____ Black Indelible Pen	
_____ Monitoring Instruments	

Attachment A Collection of Liquid-Containerized Wastes Using Glass Tubes

Discussion

Liquid samples from opened containers (i.e., 55-gallon drums) are collected using lengths of glass tubing. The glass tubes are normally 122 centimeters long and 6 to 16 millimeters inside diameter. Larger diameter tubes may be used for more viscous fluids if sampling with the small diameter tube is not adequate. The tubing is broken and discarded in the container after the sample has been collected, eliminating difficult cleanup and disposal problems. This method should not be attempted with less than a two-person sampling team.

Uses

This method provides for a quick, relatively inexpensive means of collecting concentrated containerized wastes. The major disadvantage is from potential sample loss that is especially prevalent when sampling low-viscosity fluids. Splashing can also be a problem and proper protective clothing should always be worn.

Note: A flexible tube with an aspirator attached is an alternative method to the glass tube, and allows various levels to be sampled discretely.

Procedures for Use

1. Remove cover from sample container.
2. Insert glass tubing almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 centimeters extend above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Cap the top of the tube with a safety-gloved thumb or a stopper.
5. Carefully remove the capped tube from the drum. If the tube has passed through more than one layer, the boundary should be apparent in the glass tube.
6. Insert the bottom, uncapped end into the sample container.
7. Partially release the thumb or stopper on the top of the tube and allow the sample to slowly flow into the sample container. If separation of phases is desired, cap off tube before the bottom phase has completely emptied. It may be advisable to have an extra container for "waste," so that the fluid on either side of the phase boundary can be directed into a separate container, allowing collection of pure phase liquids in the sample containers. The liquid remaining after the boundary fluid is removed is collected in yet a third container. NOTE: It is not necessary to put phases in separate containers if analysis of separate phases is not desired.
8. Repeat steps 2 through 6 if more volume is needed to fill the sample container.

9. Remove the tube from the sample container and replace the tube in the drum, breaking it, if necessary, in order to dispose of it in the drum.

Optional Method (if sample of bottom sludge is desired)

1. Remove the cover from the container opening.
2. Insert glass tubing slowly almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 cm extends above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Gently push the tube towards the bottom of the drum into the sludge layer. Do not force it.
5. Cap the top of the tube with a safety-gloved thumb or stopper.
6. Carefully remove the capped tube from the drum and insert the uncapped end into the sample container.
7. Release the thumb or stopper on the top of the tube and allow the sample container to fill to approximately 90 percent of its capacity. If necessary, the sludge plug in the bottom of the tube can be dislodged with the aid of the stainless steel laboratory spatula.
8. Repeat if more volume is needed to fill sample container and recap the tube.

Note:

1. If a reaction is observed when the glass tube is inserted (violent agitation, smoke, light, etc.), the investigators should leave the area immediately.
2. If the glass tube becomes cloudy or smoky after insertion into the drum, the presence of hydrofluoric acid maybe indicated, and a comparable length of rigid plastic tubing should be used to collect the sample.
3. When a solid is encountered in a drum (either layer or bottom sludge) the optional method described above may be used to collect a core of the material, or the material may be collected with a disposable scoop attached to a length of wooden or plastic rod.

Attachment B: Sampling Containerized Wastes using the Composite Liquid Waste Sampler (COLIWASA)

Discussion

The COLIWASA is a much-cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. The sampler is commercially available or can be easily fabricated from a variety of materials, including PVC, glass, or Teflon. In its usual configuration it consists of a 152 cm by 4 cm (inside diameter) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. See Attachment E: Construction of a COLIWASA.

Uses

The COLIWASA is primarily used to sample containerized liquids. The PVC COLIWASA is reported to be able to sample most containerized liquid wastes except for those containing ketones, nitrobenzene, dimethylformamide, mesityl oxide, and tetrahydrofuran. A glass COLIWASA is able to handle all wastes unable to be sampled with the plastic unit except strong alkali and hydrofluoric acid solutions. Due to the unknown nature of many containerized wastes, it would therefore be advisable to eliminate the use of PVC materials and use samplers composed of glass or Teflon.

The major drawback associated with using a COLIWASA is concern for decontamination and costs. The sampler is difficult, if not impossible, to decontaminate in the field, and its high cost in relation to alternative procedures (glass tubes) makes it an impractical throwaway item. It still has applications, however, especially in instances where a true representation of a multiphase waste is absolutely necessary.

Procedures for Use

1. Check to make sure the sampler is functioning properly. Adjust the locking mechanism, if present, to make sure the neoprene rubber stopper provides a tight closure.
2. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
3. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.
4. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.

5. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a laboratory wipe with the other hand. A phase boundary, if present, can be observed through the tube.
6. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.
7. Unscrew the T-handle of the sampler and disengage the locking block.

Attachment C: Sampling Containerized Wastes using the Bacon Bomb Sampler

Discussion

The Bacon Bomb is designed for the withdrawal of samples from various levels within a storage tank. It consists of a cylindrical body with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger is used to open and close the valve. A removable cover provides a point of attachment for the sample line and has a locking mechanism to keep the plunger closed after sampling. The Bacon Bomb is usually constructed of chrome-plated brass and bronze with a rubber O-ring acting as the plunger-sealing surface. Stainless steel versions are also available. The volumetric capacity is 8, 16, or 32 oz (237, 473, or 946 ml).

Uses

The Bacon Bomb is a heavy sampler suited best for viscous materials held in large storage tanks or in lagoons. If a more non-reactive sampler is needed, the stainless steel version would be used, or any of the samplers could be coated with Teflon.

Procedures for Use

1. Attach the sample line and the plunger line to the sampler.
2. Measure and then mark the sampling line at the desired depth.
3. Gradually lower the sampler by the sample line until the desired level is reached.
4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill for a sufficient length of time before releasing the plunger line to seal off the sampler.
5. Retrieve the sampler by the sample line, being careful not to pull up on the plunger line, thereby accidentally opening the bottom valve.
6. Wipe off the exterior of the sampler body.
7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.

Attachment D: Gravity Corer for Sampling Sludges in Large Containers

Discussion

A gravity corer is a metal tube with a replaceable tapered nosepiece on the bottom and a ball or other type of check valve on the top. The check valve allows water to pass through the corer on descent but prevents a washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration. Most corers are constructed of brass or steel and many can accept plastic liners and additional weights.

Uses

Corers are capable of collecting samples of most sludges and sediments. They collect essentially undisturbed samples that represent the strata profile that may develop in sediments and sludges during variations in the deposition process. Depending on the density of the substrate and the weight of the corer, penetration to depths of 75 cm (30 in.) can be attained. Exercise care when using gravity corers in vessels or lagoons that have liners because penetration depths could exceed those of the substrate; this could result in damage to the liner material.

Procedures for Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5-mm (3/16-in.) nylon line is sufficient; however, 20-mm (3/4-in.) nylon is easier to grasp during hand hoisting. An additional weight can be attached to the outside of the corer if necessary.
2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.
3. Allow corer to free fall through the liquid to the bottom.
4. Retrieve corer with a smooth, continuous, up-lifting motion. Do not bump corer because this may result in some sample loss.
5. Remove nosepiece from corer and slide sample out of corer into stainless steel or Teflon pan (preferred).
6. Transfer sample into appropriate sample bottle with a stainless steel lab spoon or laboratory spatula.

Attachment E: Construction of a Typical COLIWASA

The sampling tube consists of a 1.52-m (5-ft) by 4.13-cm (1-5/8 in) I.D. translucent plastic pipe, usually polyvinyl chloride (PVC) or borosilicate glass plumbing tube. The closure-locking mechanism consists of a short-length, channeled aluminum bar attached to the sampler's stopper rod by an adjustable swivel. The aluminum bar serves both as a T-handle and lock for the samplers' closure system. When the sampler is in the open position, the handle is placed in the T-position and pushed down against the locking block. This manipulation pushes out the neoprene stopper and opens at the sampling tube. In the closed position, the handle is rotated until one leg of the T is squarely perpendicular against the locking block. This tightly seats the neoprene stopper against the bottom opening of the sampling tube and positively locks the sampler in the closed position. The closure tension can be adjusted by shortening or lengthening the stopper rod by screwing it in or out of the T-handle swivel. The closure system of the sampler consists of a sharply tapered neoprene stopper attached to a 0.95-cm (3/8-in) O.D. rod, usually PVC. The upper end of the stopper rod is connected to the swivel of the aluminum T-handle. The sharply tapered neoprene stopper can be fabricated according to specifications by plastic-products manufacturers at an extremely high price, or it can be made in-house by grinding down the inexpensive stopper with a shop grinder.

COLIWASA samplers are typically made out of plastic or glass. The plastic type consists of translucent plastic (usually PVC) sampling tube. The glass COLIWASA uses borosilicate glass plumbing pipe as the sampling tube and a Teflon plastic stopper rod. For purpose of multiphase sampling, clear plastic or glass is desirable in order to observe the profile of the multiphase liquid.

The sampler is assembled as follows:

- a. Attach the swivel to the T-handle with the 3.18-cm (1-1/4 in) long bolt and secure with the 0.48-cm (3/16-in) National Coarse (NC) washer and lock nut.
- b. Attach the PFTE stopper to one end of the stopper rod and secure with the 0.95-cm (3/8-in) washer and lock nut.
- c. Install the stopper and stopper rod assembly in the sampling tube.
- d. Secure the locking block sleeve on the block with glue or screw. This block can also be fashioned by shaping a solid plastic rod on a lathe to the required dimension.
- e. Position the locking block on top of the sampling tube such that the sleeveless portion of the block fits inside the tube, the sleeve sits against the top end of the tube, and the upper end of the stopper rod slips through the center hole of the block.
- f. Attach the upper end of the stopper rod to the swivel of the T-handle.
- g. Place the sampler in the close position and adjust the tension on the stopper by screwing the T-handle in or out.

Attachment F: Drum Opening Techniques and Equipment ¹

I. Introduction

The opening of closed drums prior to sampling entails considerable risk if not done with the proper techniques, tools, and safety equipment. The potential for vapor exposure, skin exposure due to splash or spraying, or even explosion resulting from sparks produced by friction of the tools against the drum, necessitate caution when opening any closed container. Both manual drum opening and remote drum opening will be discussed in the following paragraphs. When drums are opened manually risks are greater than when opened remotely; for this reason, the remote opening of drums is advised whenever possible.

Prior to sampling, the drums should be staged to allow easy access. Also, any standing water or other material should be removed from the container top so that the representative nature of the sample is not compromised when the container is opened. There is also the possibility of encountering a water-reactive substance.

II. Manual Drum Opening

A. Bung Wrench

A common method for opening drums manually is using a universal bung wrench. These wrenches have fittings made to remove nearly all commonly encountered bungs. They are usually constructed of cast iron, brass, or a bronze-beryllium (a non-sparking alloy formulated to reduce the likelihood of sparks). The use of bung wrenches marked "NON SPARKING" is encouraged. However, the use of a "NON SPARKING" wrench does not completely eliminate the possibility of spark being produced. Such a wrench only prevents a spark caused by wrench-to-bung friction, but it cannot prevent sparking between the threads on the drum and the bung.

A simple tool to use, the fitting on the bung wrench matching the bung to be removed is inserted into the bung and the tool is turned counterclockwise to remove the bung. Since the contents of some drums may be under pressure (especially, when the ambient temperature is high), the bung should be turned very slowly. If any hissing is heard, the person opening the drum should back off and wait for the hissing to stop. Since drums under pressure can spray out liquids when opened, the wearing of appropriate eye and skin protection in addition to respiratory protection is critical.

B. Drum Deheader

One means by which a drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is

¹ Taken from EPA Training Course: "Sampling for Hazardous Materials," U.S. Environmental Protection Agency, Office of Emergency and Remedial Response Support Division, March 24, 1987.

constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or part way off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed head drums (i.e., DOT Specification 17E and 17F drums); drums with removable heads must be opened by other means.

Drums are opened with a drum deheader by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off if so desired. If the top chime of a drum has been damaged or badly dented it may not be possible to cut the entire top off. Since there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built-up pressure. A safer technique would be to employ a remote pressure release method prior to using the deheader.

C. Hand Pick or Spike

When a drum must be opened and neither a bung wrench nor a drum deheader is suitable, then it can be opened for sampling by using a hand pick, pickaxe, or spike. These tools are usually constructed of brass or a non-sparking alloy with a sharpened point that can penetrate the drum lid or head when the tool is swung. The hand picks or pickaxes that are most commonly used are commercially available, whereas the spikes are generally uniquely fabricated 4- foot long poles with a pointed end. Often the drum lid or head must be hit with a great deal of force in order to penetrate it. Because of this, the potential for splash or spraying is greater than with other opening methods and therefore this method of drum opening is not recommended, particularly when opening drums containing liquids. Some spikes used for drum opening have been modified by the addition of a circular splash plate near the penetrating end. This plate acts as a shield and reduces the amount of splash in the direction of the person using the spike. Even with this shield, good splash gear is essential.

Since drums, some of which may be under pressure, cannot be opened slowly with these tools, “sprayers” may result and appropriate safety measures must be taken. The pick or spike should be decontaminated after each drum is opened to avoid cross contamination and/or adverse chemical reaction from incompatible materials.

III. Remote Opening

A. Backhoe Spike

The most common means used to open drums remotely for sampling is the use of a metal spike attached or welded to a backhoe bucket. In addition to being very efficient, this method can greatly reduce the likelihood of personnel exposure.

Drums should be “staged,” or placed in rows with adequate aisle space to allow ease in backhoe maneuvering. Once staged, the drums can be quickly opened by punching a hole in the drum head or lid with the spike.

The spike should be decontaminated after each drum is opened to prevent cross contamination. Even though some splash or spray may occur when this method is used, the operator of the backhoe can be protected by mounting a large shatter-resistant shield in front of the operator's cage. This, combined with the normal sampling safety gear, should be sufficient to protect the operator. Additional respiratory protection can be afforded by providing the operator with an on-board airline system. The hole in the drum can be sealed with a cork.

B. Hydraulic Devices

Recently, remotely operated hydraulic devices have been fabricated to open drums remotely. One such device is discussed here. This device uses hydraulic pressure to pierce through the wall of a drum. It consists of a manually operated pump that pressurizes oil through a length of hydraulic line. A piercing device with a metal point is attached to the end of this line and is pushed into the drum by the hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head/lid of the drum. Some of the metal piercers are hollow or tube-like so that they can be left in place, if desired, and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.

C. Pneumatic Devices

Pneumatically-operated devices utilizing compressed air have been designed to remove drum bungs remotely. A pneumatic bung remover consists of a compressed air supply (usually SCBA cylinders) that is controlled by a heavy-duty, 2-stage regulator. A high pressure air line of desired length delivers compressed air to a pneumatic drill that is adapted to turn a bung fitting (preferably, a bronze-beryllium alloy) selected to fit the bung to be removed. An adjustable bracketing system has been designed to position and align the pneumatic drill over the bung. This bracketing system must be attached to the drum before the drill can be operated. Once the bung has been loosened, the bracketing system must be removed before the drum can be sampled. This attachment and removal procedure is time-consuming and is the major drawback of this device. This remote bung opener does not permit the slow venting of the container, and therefore appropriate precautions must be taken. It also requires the container to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

IV. Summary

The opening of closed containers is one of the most hazardous site activities. Maximum efforts would be made to ensure the safety of the sampling team. Proper protective equipment and a general wariness of the possible dangers will minimize the risk inherent to sampling operations. Employing proper drum opening techniques and equipment will also safeguard personnel. The use of remote sampling equipment whenever feasible is highly recommended.

Fish Sampling Using Electroshocking Techniques

I. Purpose

To provide a general guideline for conducting fish community surveys using electroshocking equipment.

II. Scope

A standard fish survey method is provided using electroshocking methods. Site-specific details are discussed in related sections of the Field Sampling Plan.

III. Equipment and Materials

- Field log book
- Data sheets
- Backpack electroshocker
- Boat-mounted electroshocker
- Seines
- Hip boots or chest waders
- Outer and inner rubber gloves
- Plastic bottles or containers
- Measuring board
- Cooler/Ice
- Water buckets
- Site Health and Safety Plan
- Instrument operation manuals
- Gasoline
- Formalin solution
- Waterproof labels
- Fish taxonomy keys

IV. Procedures and Guidelines

1. Fish in ponds, impoundments, lakes, and navigable streams/rivers should be collected with a boat-mounted electrofishing unit.
2. Fish in wetlands and wadable streams should be collected with a backpack electrofishing unit.

3. Sample intervals to be conducted at sample station should consist of approximately 30 minutes of shocking time or until no new fish species are collected in 10 minutes of shocking. Actual shocking time is to be recorded for each sample.
4. Fish will be collected with a long-handled dip net and placed in to a live well (tank) or bucket. Any fish not being kept for chemical analytical tissue samples, will be returned to the water As soon as possible
5. Information on species, size class, location and physical condition will be recorded for each fish captured. Record the proportion of individuals as hybrids and the proportion of individuals with DELTs (deformities, erosion [fins], lesions or tumors), other signs of disease, skeletal anomalies, and any other pertinent information on a field data sheet.
6. If too difficult to identify the specimen, or specimen are too numerous for effective field processing, preserve them for later processing (10% Formalin or 95% ethanol), and transport them to the office or laboratory for taxonomic work and measurements.
7. Sampling equipment including the fish measuring board will be cleaned and rinsed between each sample station.
8. Sample stations will be mapped and information on habitat condition of each sample station will be recorded including water depth, substrate type, shoreline profile or vegetation and degree of shading.
9. Photographs of sample stations in ponds, wetlands and creek habitats should be taken to supplement written descriptions.

V. Attachments

None

VI. Key Checks and Items

- Follow recommended safety precautions in operating the fish electroshocking equipment.
- Clean sample equipment between sample stations.

Fish Sampling Using Gill Nets

I. Purpose

The purpose of this SOP is to provide general reference information and technical guidance on the procedure to sample and characterize fish communities using gill net procedures. The collected samples provide information used in the determination of population statistics of the fish community and can be used to collect fish samples for chemical analysis of tissues. This information will be used in the assessment of risks to human health and the environment.

II. Scope

This guideline provides information on proper sampling equipment and techniques for the collection of fish in streams, ponds, and near shore areas of lakes, impoundments, bays, and estuaries, and the ocean shoreline. This technique is most effective in slow moving streams and rivers, and open areas in lakes and impoundments. Swift moving water bodies tend to tangle the nets.

Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The technique described should be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methods.

III. Equipment and Materials

- Sampling boat
- Gill nets (the size mesh is dependent on the size fish desired for collection)
- Flotation and weights to properly set the nets
- Fish Measuring Board
- 0-16 oz scale, 1-4 lb scale, 1-15 lb scale
- Live Well (large tub) with overflow pipe to outside of boat
- Appropriate sampling keys for species to be sampled, and any required instruments to aid in the identification
- Field sampling data sheets
- Glass jars for storage of fish
- Formalin
- Black Permanent Marker
- Camera
- Required Personal Protective Equipment
- Portable Air Pumps
- Field log book

- Fish scale envelopes
- Tweezers
- Additional line and couplings
- Tools (pliers, variable wrench, hammer)

IV. Procedures

The primary consideration for collecting fish using gill nets is identifying sampling locations where there is a steady traffic of fish. Accurate and timely deployment and retrieval of the gill nets is a key variable in the success of the fish collection effort. Detailed procedures for conducting fish populations utilizing gill nets are described in the sections to follow.

A. Preliminary Activities

Apply-for- and receive applicable scientific collection permits as required by the state agencies with purview over the project site. Contact local fish & game and/or law enforcement officials and inform them of your activities.

Collect and determine all information pertinent to the fish sampling project, including water depth, station locations, nearby boat access locations, known sediment contamination, tidal variation, any waterway obstructions or inconsistencies (e.g. shallow or grassy areas, low structures, pipe crossings), any other biological studies previously conducted on or near the site, species used locally for human consumption and the degree of such consumption species most likely present, and the most appropriate sampling method for the species of interest that is permitted by law.

Before sampling occurs, conduct a site reconnaissance using a site map. The objective of this exercise is to categorize habitats, and map dividing lines and descriptors identifying the various types of habitats available. Make notations on the map depicting the abiotic characteristics of the reach including features such as substrate, water depth, channel shape, degree of bank erosion, piers, boat traffic, commercial trawling, potting activities, and relative current velocity and direction. Also make notations on the site map to show biotic characteristics of the reach including fish species observed, evidence of fisherman use, and aquatic and riparian vegetation including wetlands. In addition, identify station locations at this point, along with the total area to be sampled. Choose the station locations, where possible, to represent ecologically similar aquatic environments.

Ensure adequate number of sample collection jars and volume of preservative needed.

Set up a live well (e.g., large cooler, 50-gallon container) with site water.

B. Operating Procedure

Determine the area to be sampled, and mark it with flagging, if possible. Field personnel that are setting the net should be standing on the platform on the bow of the boat. Place one end of the gill net with a weight attached to the bottom and a

buoy attached to the top into the water, stretch the gill net (do not leave slack) across the area to be sampled by pulling it along with the boat. If there is a discernible flow, the net will be set in the upstream direction.

The net should remain in the sample location for 8 to 12 hours before retrieving. Field personnel that are collecting the fish should be standing on the platform on the bow of the boat. The net should be pulled slowly from the water and the collected fish removed as the net is being removed from the water. Place the collected fish into the live wells.

Conduct sampling in areas that will ensure adequate qualitative and/or quantitative representation of the fish community, whichever is necessary. These areas should include riffles/runs, shorelines, snags, natural fish holding areas, vegetation beds and other habitats.

Upon retrieval of a gill net, identify, measure, weigh and release the specimens. Record the proportion of individuals as hybrids and the proportion of individuals with DELTs (deformities, erosion [fins], lesions or tumors), other signs of disease, skeletal anomalies, and any other pertinent information on a field data sheet.

To the extent possible, process all species in the field and return them to the water alive. If too difficult to identify the specimen, or specimen are too numerous for effective field processing, preserve them for later processing (10% Formalin or 95% ethanol), and transport them to the office or laboratory for taxonomic work and measurements.

At a minimum, preserve one representative fish from each species as a voucher specimen. Record the station location, date sampled, and species name on the label.

The following information will be recorded in the field logbook:

- Sample identification (site name, location, project no.; sample name/number and location; sample type and matrix; time and date; sampler's identity).
- Field observations and measurements (sample setting, appearance of substrate, sampling method, and photograph descriptions).
- Additional remarks, as appropriate.

Record all observations in the field logbook. Complete field sheets for the collected samples.

VI. References

Brower, 1977. James E. Brower and H. Jerrold Zar. *Field and Laboratory Methods for General Ecology*. Wm. C. Brown Company Publishers. 1977.

Ricker, 1971. Ricker, W.E. *Methods for Assessment of Fish Production in Fresh Waters*, International Biological Programme Handbook No. 3. 1971.

U.S. EPA, 1987. U.S. Environmental Protection Agency. *A Compendium of Superfund Field Operations Methods*. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement. December 1987.

U.S. EPA, 1989. Warren-Hicks, William, Parkhurst, Benjamin R., Baker, Samuel S. Jr. *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference*. U.S. EPA, Environmental Research Laboratory, Corvallis, OR 97333. March 1989.

Fish Sampling Using Seines

I. Purpose

The purpose of this SOP is to provide general reference information and technical guidance on the procedure to sample and characterize fish communities using seining procedures. The collected samples provide information used in the determination of population statistics of the fish community and can be used to collect fish samples for chemical analysis of tissues. This information will be used in the assessment of risks to human health and the environment.

II. Scope

This guideline provides information on proper sampling equipment and techniques for the collection of fish in shallow streams, ponds, and near shore areas of lakes, impoundments, bays, estuaries, and ocean shoreline. This technique is more suited for use in smooth bottomed, low-sloped areas.

This procedure is not very effective when the seine is pulled over weeds and other obstructions as they may tend to roll up, and allow the fish to pass under the seine.

Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The technique described should be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methods.

III. Equipment and Materials

- Seine
- Fish Measuring Board
- 0-16 oz scale, 1-4 lb scale, 1-15 lb scale
- Appropriate sampling keys for species to be sampled, and any required instruments to aid in the identification
- Live Well (large tub) with overflow pipe to outside of boat
- Field sampling data sheets
- Glass jars for storage of fish
- Preservative (10% formalin or 95% ethanol)
- Black Permanent Marker
- Camera
- Required Personal Protective Equipment
- Portable Air Pumps

IV. Procedures

The primary considerations for collecting fish for population studies include identifying sampling locations, proper sampling techniques for the haul seine and proper documentation of samples. Detailed procedures for conducting fish populations utilizing the haul seine are described in the sections to follow.

A. Preliminary Activities

Apply-for- and receive applicable scientific collection permits as required by the state agencies with purview over the project site. Contact local fish & game and/or law enforcement officials and inform them of your activities.

Collect and determine all information pertinent to the fish sampling project, including water depth, station locations, nearby boat access locations, known sediment contamination, tidal variation, any waterway obstructions or inconsistencies (e.g. shallow or grassy areas, low structures, pipe crossings), any other biological studies previously conducted on or near the site, species used locally for human consumption and the degree of such consumption species most likely present, and the most appropriate sampling method for the species of interest that is permitted by law.

Before sampling occurs, conduct a site reconnaissance using a site map. The objective of this exercise is to categorize habitats, and map dividing lines and descriptors identifying the various types of habitats available. Make notations on the map depicting the abiotic characteristics of the reach including features such as substrate, water depth, channel shape, degree of bank erosion, piers, boat traffic, commercial trawling, potting activities, and relative current velocity and direction. Also make notations on the site map to show biotic characteristics of the reach including fish species observed, evidence of fisherman use, and aquatic and riparian vegetation including wetlands. In addition, identify station locations at this point, along with the total area to be sampled. Choose the station locations, where possible, to represent ecologically similar aquatic environments.

Ensure adequate number of sample collection jars and volume of preservative needed.

Set up a live well (e.g., large cooler, 50-gallon container) with site water.

B. Operating Procedure

Determine the area to be sampled, and mark it with flagging, if possible. Stretch the seine across the area to be sampled, with a minimum of one field personnel on either side of the seine. Ensure that the weighted side of the seine is at the bottom. Best results are achieved when the water level is no deeper than two thirds the height of the slack net.

Rapidly walk through the water at the same speed, while keeping a constant distance apart. If sampling in a stream, walk upstream against the current. As the end of the sampling area approaches, Pull the seine rapidly toward the shore, and lift the weighted end out of the water. Place the collected fish into the live wells.

If other field personnel are present, have them walk towards the seine to chase the fish in that direction. In addition, have them help to lift the seine when the sampling effort is complete.

Conduct sampling in areas that will ensure adequate qualitative and/or quantitative representation of the fish community, whichever is necessary. These areas should include riffles/runs, shorelines, snags, natural fish holding areas, vegetation beds and other habitats.

At the end of a sampling reach, identify, measure, weigh and release the specimens. Record the proportion of individuals as hybrids and the proportion of individuals with DELTs (deformities, erosion [fins], lesions or tumors), other signs of disease, skeletal anomalies, and any other pertinent information on a field data sheet.

To the extent possible, process all species in the field and return them to the water alive. If too difficult to identify the specimen, or specimen are too numerous for effective field processing, preserve them for later processing (10% Formalin or 95% ethanol), and transport them to the office or laboratory for taxonomic work and measurements.

At a minimum, preserve one representative fish from each species as a voucher specimen. Record the station location, date sampled, and species name on the label.

The following information will be recorded in the Field Logbook:

- Sample identification (site name, location, project no.; sample name/number and location; sample type and matrix; time and date; sampler's identity).
- Field observations and measurements (sample setting, appearance of substrate, sampling method, and photograph descriptions).
- Additional remarks, as appropriate.

Record all observations in the Field Logbook as described in SOP F202. Complete field sheets for the collected samples.

V. References

Brower, 1977. James E. Brower and H. Jerrold Zar. *Field and Laboratory Methods for General Ecology*. Wm. C. Brown Company Publishers. 1977.

Ricker, 1971. Ricker, W.E. *Methods for Assessment of Fish Production in Fresh Waters*. International Biological Programme Handbook No. 3. 1971.

U.S. EPA, 1987. U.S. Environmental Protection Agency. *A Compendium of Superfund Field Operations Methods*. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement. December 1987.

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Global Positioning System

I. Purpose

The procedure describes the calibration, operation, and functions associated with a Trimble® Pro XRS GPS Unit with a TSC-1 Asset Surveyor for datalogging. GPS signal information is differentially corrected to sub-meter accuracy on a continual basis using a second satellite signal broadcast from OmniSTAR satellite subscription service. The procedure applies to all field data collection activities.

II. Scope

This procedure provides information regarding the field operation and general maintenance of a Trimble® Pro XRS GPS Unit with a TSC-1 Asset Surveyor for datalogging. The information contained herein presents the operation procedures for this equipment. Review of the equipment's instruction manual is a necessity for more detailed descriptions pertaining to the operation and maintenance of the equipment.

III. Definitions

GPS: Global Positioning System - A system of 24 satellites developed and operated by the US DOD. Continuous 3D coordinate information is broadcast free of charge on a worldwide basis enabling precise positional location. Three standard categories of positional accuracy are generally used:

1. Uncorrected Signal - accuracy +/-10 meters - a single satellite transmission is used
2. Differentially Corrected Signal - accuracy +/- <1 meter - additional positional transmissions are recorded simultaneously and used to triangulate coordinate position.
3. Carrier Phase Signal- accuracy +/- <1 centimeter - requires a second receiver and additional software. Both receivers need to be equipped to receive Carrier Phase signals.

IV. Procedures and Guidelines

The procedure for calibration, operation, and maintenance of the GPS unit is outlined below. Daily calibration and battery recharging is typical operating procedure; frequencies other than daily shall be noted in the logbook and reason for increased frequency recorded. If using a different instrument, the operation manual supplied by the manufacturer should be consulted for instructions.

The procedures described below include additional features pre-programmed into the GPS datalogger to aid the data collection process.

A. Calibration

1. Check to ensure that the datalogger and antenna cables are properly connected to the receiver and that the batteries are securely connected.
2. Turn the datalogger unit on by pressing the green **On** key in the bottom left corner. The datalogger will perform a self-calibration. Wait to ensure that the antenna is receiving a sufficient number of satellite signals (usually a minimum of 3).
3. Once the datalogger receives a satellite signal then it is ready for operation.

B. Operations for surveying coordinates of a location

1. The datalogger and GPS receiver are ready for use after the initial self-calibration.
2. Field data may be immediately recorded in the datalogger.
3. The first screen view is the 'Main Menu'. Use the round keypad to select 'Data Collection' and press the **Enter** key.
4. Use the round keypad to select either 'Create new file' or 'Open existing file' and press the **Enter** key. It is not necessary to create a new file at each new location; however, it may be useful to create a new file at the beginning of each day.
5. If a new file is created then the GPS unit will automatically assign it a file name. The file name may be changed if desired. Press the enter key after the file name is assigned. If opening an existing file then use the round keypad to scroll through existing file names.
6. The next screen is 'Antenna options'. Press the **Enter** key to move to the next screen.
7. Select the type of activity to be performed. At the beginning of each day 'Sample Site Detail' should be completed. This allows the operator to enter each field team member, weather, objectives, health and safety meetings, etc. Once the 'Sample Site Detail' is completed then data entry activities may begin including well purging, water level elevations, and sample collection
8. The datalogger prompts the operator when a data field is required and by using the round key pad, numeric, alphanumeric, enter, and escape keys, the operator can perform electronic data capture on the GPS datalogger.
9. Once all information pertaining to an individual site has been recorded, press enter to complete data entry. If GPS signal is obstructed (tree canopy, building height, etc) user may choose to remain in same location until satellite transmission clears the obstruction. This usually takes only a few moments. Data may still be captured and recorded electronically even if GPS signal is insufficient for positioning.
10. To shut down, press the **Escape** key to return to the 'Main Menu'. The unit can be turned off by pressing the green key in the left hand corner. The datalogger should only be turned off when the 'Main Menu' screen is displayed.
11. All data from the datalogger should be downloaded into Trimble Pathfinder Office software on a PC a minimum of once daily. It is recommended that data is downloaded twice daily. Data may be viewed and mapped using Pathfinder Office or exported to

other software. Export file formats support standard ASCII text, generic database .dbf and most GIS and CAD software.

C. Operations for locating a point using coordinates/reacquiring a previously surveyed location

1. The datalogger and GPS receiver are ready for use after the initial self-calibration.
2. Use the Trimble Pathfinder software to load the data file containing the coordinates for each desired location ("programmed location").
3. The first screen view is the 'Main Menu'. Use the keypad to select 'Navigation' and press the **Enter** key.
4. Use the round keypad to select 'Open existing file' to open the file loaded in Step 2 above.
5. Select the location to be reacquired from the screen and press the enter key.
6. A circle with an arrow will appear. As you begin walking, the arrow will point in the direction of the programmed location. Walk in the direction indicated by the arrow.
7. Once you are within 10-feet of the location being reacquired, the GPS unit will display a circle (representing the programmed location) and an "X" (representing the GPS unit). Continue to walk in the direction of the circle until the "X" is centered in the circle. Once the "X" is centered, you are standing at the programmed location.
8. To shut down, press the **Escape** key to return to the 'Main Menu'. The unit can be turned off by pressing the green key in the left hand corner. The datalogger should only be turned off when the 'Main Menu' screen is displayed.

D. Preventive Maintenance

The antenna and datalogger are weatherproof. It is recommended that the receiver remain in the provided backpack carrier. Care should be taken not to crease, pinch or bend the antenna cable. Data should be downloaded from the datalogger a minimum of once daily, twice daily is preferred. At the end of each day the receiver batteries should be recharged. For technical assistance call the rental company through which you acquired the Trimble® unit. Guidance is also provided in the manual and at <http://www.trimble.com>.

Homogenization of Soil and Sediment Samples

I. Purpose

The homogenization of soil and sediment samples is performed to minimize any bias of sample representativeness introduced by the natural stratification of constituents within the sample.

II. Scope

Standard techniques for soil and sediment homogenization and equipment are provided in this SOP. These procedures do not apply to aliquots collected for VOCs or field GC screening; samples for these analyses should NOT be homogenized.

III. Equipment and Materials

Sample containers, stainless steel spoons or spatulas, and stainless steel pans.

IV. Procedures and Guidelines

Soil and sediment samples to be analyzed for semivolatiles, pesticides, PCBs, metals, cyanide, or field XRF screening should be homogenized in the field. After a sample is taken, a stainless steel spatula should be used to remove the sample from the split spoon or other sampling device. The sampler should not use fingers to do this, as gloves may introduce organic interferences into the sample.

Samples for VOCs should be taken immediately upon collection and should not be homogenized.

Prior to homogenizing the soil or sediment sample, any rocks, twigs, leaves, or other debris should be removed from the sample. The sample should be placed in a decontaminated stainless steel pan and thoroughly mixed using a stainless steel spoon. The soil or sediment material in the pan should be scraped from the sides, corners, and bottom, rolled into the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the pan and mixed with the entire sample again.

All stainless steel spoons, spatulas, and pans must be decontaminated following procedures specified in SOP *Decontamination of Personnel and Equipment* prior to homogenizing the sample. A composite equipment rinse blank of homogenization equipment should be taken each day it is used.

V. Attachments

None.

VI. Key Checks and Items

- Take VOC samples immediately and do not homogenize the soil.
- Homogenize soil for analyses other than VOCs in a clean, stainless steel bowl.

Preparing Field Log Books

I. Purpose

This SOP provides general guidelines for entering field data into log books during site investigation and remediation activities.

II. Scope

This is a general description of data requirements and format for field log books. Log books are needed to properly document all field activities in support of data evaluation and possible legal activities.

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

Properly completed field log books are a requirement for much of the work we perform under the Navy CLEAN contract. Log books are legal documents and, as such, must be prepared following specific procedures and must contain required information to ensure their integrity and legitimacy. This SOP describes the basic requirements for field log book entries.

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

1. Field notes commonly are kept in bound, hard-cover logbooks used by surveyors and produced, for example, by Peninsular Publishing Company and SESCO, Inc. Pages should be water-resistant and notes should be taken only with water-proof, non-erasable permanent ink, such as that provided in Sanford Sharpie® permanent markers.
2. On the inside cover of the log book the following information should be included:
 - Company name and address
 - Log-holders name if log book was assigned specifically to that person
 - Activity or location

- Project name
 - Project manager's name
 - Phone numbers of the company, supervisors, emergency response, etc.
3. All lines of all pages should be used to prevent later additions of text, which could later be questioned. Any line not used should be marked through with a line and initialed and dated. Any pages not used should be marked through with a line, the author's initials, the date, and the note "Intentionally Left Blank."
 4. If errors are made in the log book, cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the personnel performing the correction. If possible, all corrections should be made by the individual who made the error.
 5. Daily entries will be made chronologically.
 6. Information will be recorded directly in the field log book during the work activity. Information will not be written on a separate sheet and then later transcribed into the log book.
 7. Each page of the log book will have the date of the work and the note takers initials.
 8. The final page of each day's notes will include the note-takers signature as well as the date.
 9. Only information relevant to the subject project will be added to the log book.
 10. The field notes will be copied and the copies sent to the Project Manager or designee in a timely manner (at least by the end of each week of work being performed).

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

1. Entries into the log book should be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. Entries must be legible and complete.
2. General project information will be recorded at the beginning of each field project. This will include the project title, the project number, and project staff.
3. Scope: Describe the general scope of work to be performed each day.
4. Weather: Record the weather conditions and any significant changes in the weather during the day.
5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified,

and corrective actions or adjustments made to address concerns/problems, and other pertinent information.

6. Standard Health and Safety Procedures: Record level of personal protection being used (e.g., level D PPE), record air monitoring data on a regular basis and note where data were recording (e.g., reading in borehole, reading in breathing zone, etc). Also record other required health and safety procedures as specified in the project specific health and safety plan.
7. Instrument Calibration; Record calibration information for each piece of health and safety and field equipment.
8. Personnel: Record names of all personnel present during field activities and list their roles and their affiliation. Record when personnel and visitors enter and leave a project site and their level of personal protection.
9. Communications: Record communications with project manager, subcontractors, regulators, facility personnel, and others that impact performance of the project.
10. Time: Keep a running time log explaining field activities as they occur chronologically throughout the day.
11. Deviations from the Work Plan: Record any deviations from the work plan and document why these were required and any communications authorizing these deviations.
12. Health and Safety Incidents: Record any health and safety incidents and immediately report any incidents to the Project Manager.
13. Subcontractor Information: Record name of company, record names and roles of subcontractor personnel, list type of equipment being used and general scope of work. List times of starting and stopping work and quantities of consumable equipment used if it is to be billed to the project.
14. Problems and Corrective Actions: Clearly describe any problems encountered during the field work and the corrective actions taken to address these problems.
15. Technical and Project Information: Describe the details of the work being performed. The technical information recorded will vary significantly between projects. The project work plan will describe the specific activities to be performed and may also list requirements for note taking. Discuss note-taking expectations with the Project Manager prior to beginning the field work.
16. Any conditions that might adversely affect the work or any data obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

17. Sampling Information; Specific information that will be relevant to most sampling jobs includes the following:
- Description of the general sampling area – site name, buildings and streets in the area, etc.
 - Station/Location identifier
 - Description of the sample location – estimate location in comparison to two fixed points – draw a diagram in the field log book indicating sample location relative to these fixed points – include distances in feet.
 - Sample matrix and type
 - Sample date and time
 - Sample identifier
 - Draw a box around the sample ID so that it stands out in the field notes
 - Information on how the sample was collected – distinguish between “grab,” “composite,” and “discrete” samples
 - Number and type of sample containers collected
 - Record of any field measurements taken (i.e. pH, turbidity, dissolved oxygen, and temperature, and conductivity)
 - Parameters to be analyzed for, if appropriate
 - Descriptions of soil samples and drilling cuttings can be entered in depth sequence, along with PID readings and other observations. Include any unusual appearances of the samples.

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

1. Use the left side border to record times and the remainder of the page to record information (see attached example).
2. Use tables to record sampling information and field data from multiple samples.
3. Sketch sampling locations and other pertinent information.
4. Sketch well construction diagrams.

V. Attachments

Example field notes.

(47)

MAY 12, 2003

EXAMPLE

0715 ARRIVE ON SITE AT XYZ SITE.
CH2M HILL STAFF:
John Smith: FIELD TEAM LEADER
Bob Builder: SITE SAFETY COORD.
WEATHER: OVERCAST + COOL, 45°F
CHANCE OF LATE SHOWERS
SCOPE: • COLLECT GROUNDWATER
SAMPLES FOR LTM WORK AT SITE 14
• SUPERVISE SURVEY CREW
AT SITE 17

0725 BB ~~Calibrates~~ JS Calibrates
PID: 101 ppm/100 ppm OK
PID Model #, SERIAL #

0730 BB Calibrates HORIBA METER
Model #, SERIAL #
→ List calibration RESULTS

0738 Survey CREW ARRIVES ON SITE
→ List NAMES

0745 BB Holds H+S TALK ON Slips,
Trips, Falls, Ticks + Air Monitoring
JS + SURVEY CREW ATTEND
No H+S ISSUES IDENTIFIED AS
CONCERNS. All work is in "LEVEL D."

0755 JS Conducts site-WIDE Air Monitoring
All readings = 0.0 ppm in

JS
5-12-03

MAY 12, 2003

EXAMPLE

(48)

SITE 14 LTM
Breathing Zone (BZ)

0805 Mobilize to well MW-22 to
SAMPLE, surveyors SETTING UP
AT SITE 17

0815 PM (PAUL PAPER PUSHER) CALLS AND
INFORMS JS TO collect GWO SAMPLE
AT well MW-44 today for 24 hr
TAT ANALYSIS OF VOC'S

0820 Purging MW-22
→ RECORD WATER QUALITY DATA JS
5-12-03

0843 Collect SAMPLE AT MW-22 for
total TAT Metals AND VOC'S, NO
Dissolved Metals Needed per PM

0905 JS + BB Mobilize to SITE 17 to
show surveyors wells to survey.

0942 Mobilize to well MW-22 to
collect SAMPLE...

0950 CAN NOT ACCESS well MW-22
due to BASE OPERATIONS; CONTACT
PAUL PAPER PUSHER AND HE STATED
HE WILL CHECK ON GAINING ACCESS
WITH BASE CONTACT.

0955 Mobilize to well MW-19

JS
5-12-03

Low-Flow Groundwater Sampling from Monitoring Wells – EPA Region I and III

I. Purpose and Scope

This SOP presents general guidelines for the collection of groundwater samples from monitoring wells using low-flow purging and sampling procedures. Operations manuals should be consulted for specific calibration and operating procedures.

II. Equipment and Materials

- Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump
- Horiba® U-22 or equivalent water quality meters to monitor pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature
- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- Generator or alternate power source depending on pump type
- Water-level indicator
- Disposable Teflon, Teflon-lined polyethylene tubing or polyethylene tubing for metals and other inorganics
- Plastic sheeting
- Well-construction information
- Calibrated container and stopwatch to determine flow rate
- Sample containers
- In-line disposable 0.45µm filters (QED® FF8100 or equivalent)
- Shipping supplies (labels, coolers, and ice)
- Field book

III. Procedures and Guidelines

A. Setup and Purging

1. Obtain information on well location, diameter(s), depth, and screen interval(s), and the method for disposal of purged water.
2. Calibrate instruments according to manufacturer's instructions.
3. The well number, site, date, and condition are recorded in the field logbook.

4. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed. To avoid cross-contamination, do not let any downhole equipment touch the ground.
5. All sampling equipment and any other equipment to be placed in the well is cleaned and decontaminated before sampling in accordance with *SOP Decontamination of Personnel and Equipment*.
6. Water level measurements are collected in accordance with the *Water Level Measurements SOP*. **Do not measure the depth to the bottom of the well at this time**; this reduces the possibility that any accumulated sediment in the well will be disturbed. Obtain depth to bottom information from well construction log.
7. Attach and secure the tubing to the low-flow pump. Lower the pump slowly into the well and set it at approximately the middle of the screen. Place the pump intake in the middle of the saturated screen length and should be at least two feet above the bottom of the well to avoid mobilization of any sediment present in the bottom.
8. Insert the measurement probes into the flow-through cell. The purged groundwater is directed through the cell, allowing measurements to be collected before the water contacts the atmosphere.
9. If using a generator, locate it 30 feet downwind from the well to avoid exhaust fumes contaminating the samples.
10. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Purging rates for more transmissive formations could be started at 0.5-liter to 1 liter per minute. The initial field parameters of pH, specific conductance, dissolved oxygen, ORP, turbidity, and temperature of water are measured and recorded in the field logbook.
11. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.3-foot). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1- to 0.2-liter per minute) to avoid affecting well drawdown.
12. During purging, the field parameters are measured frequently (every 5 minutes) until the parameters have stabilized. Field parameters are considered stable when measurements meet the following criteria:
 - pH: within 0.1 pH units

- Specific conductance: within 3 percent
- Dissolved oxygen: within 10 percent
- Turbidity: within 10 percent for values greater than 5 NTU; if 3 turbidity values are less than 5 NTU, consider the values as stabilized
- ORP: within 10 mV
- Temperature: within 3 percent

B. Sample Collection

Once purging is complete the well is ready to sample. The elapsed time between completion of purging and collection of the groundwater sample should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in sample containers that have been cleaned to laboratory standards and are preserved in accordance with the analytical method. The containers are typically pre-preserved, if required.

VOC samples are normally collected first and directly into pre-preserved sample containers.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that $\frac{1}{4}$ or $\frac{3}{8}$ inch inside diameter tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, collect non-VOC dissolved gasses samples first, then increase flow rate slightly until water completely fills the tubing and collect the VOC/dissolved gases samples. Record new flow rate and drawdown depth.

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly poured from the bailer or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.
3. Inorganics, including metals, may be collected and preserved in the filtered form as well as the unfiltered form. Disposable in-line filters (0.45 micron filter), connected to the end of the sample tubing,, are typically used for field filtration. Samples are field filtered as the water is being placed into the sample container. If a bailer is used, filtration may be driven by a peristaltic pump.

4. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to the top with a positive meniscus.
5. The bottle is capped and clearly labeled.
6. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical.
7. Nondedicated equipment is cleaned and decontaminated in accordance with the *Decontamination of Personnel and Equipment* SOP.

The following information, at a minimum, will be recorded in the log book:

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservative; laboratory name, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)
5. Additional remarks

C. Additional remarks

1. If the well goes dry during purging, wait until it recovers sufficiently to remove the required volumes to sample all parameters. It may be necessary to return periodically to the well but a particular sample (e.g., large amber bottles for semivolatile analysis) should be filled at one time rather than over the course of two or more visits to the well.
2. Disposable tubing is disposed of with PPE and other site trash.

IV. Attachments

White paper on reasons and rationale for low-flow sampling.

V. Key Checks and Preventative Maintenance

- The drawdown in the well should be minimized as much as possible (preferably no more than 0.5-foot to 1 foot) so that natural groundwater-flow conditions are maintained as closely as possible.
- The highest purging rate should not exceed 1 liter per minute. This is to keep the drawdown minimized.

- Stirring up of sediment in the well should be avoided so that turbidity containing adsorbed chemicals is not suspended in the well and taken in by the pump.
- Overheating of the pump should be avoided to minimize the potential for losing VOCs through volatilization.
- Keep the working space clean with plastic sheeting and good housekeeping.
- Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:
 - Inspect sampling pump regularly and replace as warranted
 - Inspect quick-connects regularly and replace as warranted
 - Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

Attachment to the SOP on Low-Flow Sampling Groundwater Sampling from Monitoring Wells

White Paper on Low-Flow Sampling

EPA recommends low-flow sampling as a means of collecting groundwater samples in a way that minimizes the disturbance to the natural groundwater flow system and minimizes the introduction of contamination into the samples from extraneous sources. The following are details about these issues.

When a pump removes groundwater from the well at the same rate that groundwater enters the well through the screen, the natural groundwater-flow system around the well experiences a minimum of disturbance. Some disturbance is bound to occur because you are causing groundwater to flow to the well in a radial fashion that otherwise would have flowed past it. However, the resulting low-flow sample provides the most-representative indication we can get of groundwater quality in the immediate vicinity of the well.

Normally, when a well is pumped at an excessive rate that drops the water level in the well below the water level in the aquifer, the water cascades down the inside of the well screen when it enters the well. The turbulence from this cascading causes gases such as oxygen and carbon dioxide to mix with the water in concentrations that are not representative of the native groundwater and are higher than expected. This causes geochemical changes in the nature of the water that can change the concentrations of some analytes, particularly metals, in the groundwater sample, not mention it's effect on the dissolved oxygen levels that then will be measured in the flow-through cell. Such turbulence also may cause lower-than-expected concentrations of volatile organic compounds due to volatilization.

For wells in which the water level is above the top of the screen, the water up in the riser is out of the natural circulation of the groundwater and, therefore, can become stagnant. This stagnant water is no longer representative of natural groundwater quality because its pH, dissolved-oxygen content, and other geochemical characteristics change as it contacts the air in the riser. If we minimize the drawdown in the well when we pump, then we minimize the amount of this stagnant water that is brought down into the well screen and potentially into the pump. As a result, a more-representative sample is obtained.

Typically, wells contain some sediment in the bottom of the well, either as a residue from development that has settled out of the water column or that has sifted through the sand pack and screen since the well was installed. This sediment commonly has adsorbed on it such analytes as metals, SVOCs, and dioxins that normally would not be dissolved in the groundwater. If these sediments are picked up in the groundwater when the well is disturbed by excessive pumping, they can:

- Make filtering the samples for metals analysis more difficult
- Add unreasonably to the measured concentration of SVOCs and other organic compounds

The SOP for low-flow sampling has been modified recently and should be consulted for additional information about low-flow sampling and ways of dealing with wells in which the water level cannot be maintained at a constant level.

Mini RAE Photoionization Detector (PID)

I. Purpose

The purpose of this SOP is to provide general reference information for using the Mini RAE PID in the field. Calibration and operation, along with field maintenance, will be included in this SOP.

II. Scope

This procedure provides information on the field operation and general maintenance of the Mini RAE PID. Review of the information contained herein will ensure that this type of field monitoring equipment will be properly utilized. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

III. Definitions

Volatile Organic Compound (VOC) – Expresses the VOC concentration in ppm
ppm - parts per million: parts of vapor or gas per million parts of air by volume.

IV. Procedures

The Mini RAE utilizes the principle of a detecting sensor. The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecules and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called photo ionization potential (PIP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For

environments where background readings are high, factory zero calibration gas should be used.

Note: For volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the QAPP and manufacturer's manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 eV, it is possible to use a PID. If the ionization potential is greater than 11.7eV, an FID is required.

The following subsections will discuss Mini RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

A. Calibration

Start up Instrument

- Press **Mode** button
- Observe displays:

On!.....

Version X.XX

Model Number
SN XXXX

Date Time
Temp

- After the monitor is turned on and it runs through the startup menus, the display will read "Ready". Press the [Y/+] key to start the pump.
- The pump will start, the seconds will count down to zero, and the instrument will be ready for use

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

- Depress the [N/-] key first, then while depressing the [N/-], depress the [Mode] key also and depress both keys for 5 seconds.
- Display will read:

Calibrate
Monitor?
- Press the [Y/+] key
- Display will read:

Fresh Air
Calibration?

- Perform the Fresh Air Calibration in an area free of any detectable vapor near your work zone.
- Press the [Y/+] key
- Display will read:

Zero....
In progress...

Wait...

Update data...

Zeroed...

Reading = X.X ppm

- Press any key and the display will go back to:

Fresh Air
Calibration?

- Press the [N/+] key
- Display will read:

Span/Cal?

- Press the [Y/+] key
- Display will read:

Isobutylene = 100 ppm

Apply Gas Now!

- Press the [Y/+] key
- Apply calibration gas – use either HAZCO Services Part Number R-SGRAE4 or Rae Systems Part Number 008-3002 – using a .5 LPM regulator and direct tubing.

Wait...30

- The display will count down showing the number of remaining seconds:

Reading = 100

Update data, span cal done.
Turn off gas!

- Calibration readings between 99 and 102 ppm are within the acceptable range.
- Display will read:

Span/Cal?

- **CALIBRATION IS COMPLETE!**
- Press any key to return to operational mode.

B. Operation

Due to the Mini RAE having many functions in terms of operation, it is recommended that you follow the operational procedures as outlined in the instruction manual from pages 2-5 to 2-14.

C. Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

D. Scheduled Maintenance

<u>Function</u>	<u>Frequency</u>
Check alarm and settings	Monthly/before each use
Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

V. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook.

- Identification - Site name, date, location, CTO number, activity monitored, (surface water sampling, soil sampling, etc), serial number, time, resulting concentration, comments and identity of air monitoring personnel.
- Field observations - Appearance of sampled media (if definable).
- Additional remarks (e.g, Mini RAE had wide range fluctuations during air monitoring activities.)

VI. References

Mini RAE 2000 Portable VOC PGM-7600, RAE Systems, Revision E, May 2005.

MultiRAE Plus

PGM-50/4, PGM-50/4P, PGM-50/5P
Multiple-Gas Monitor



USER MANUAL

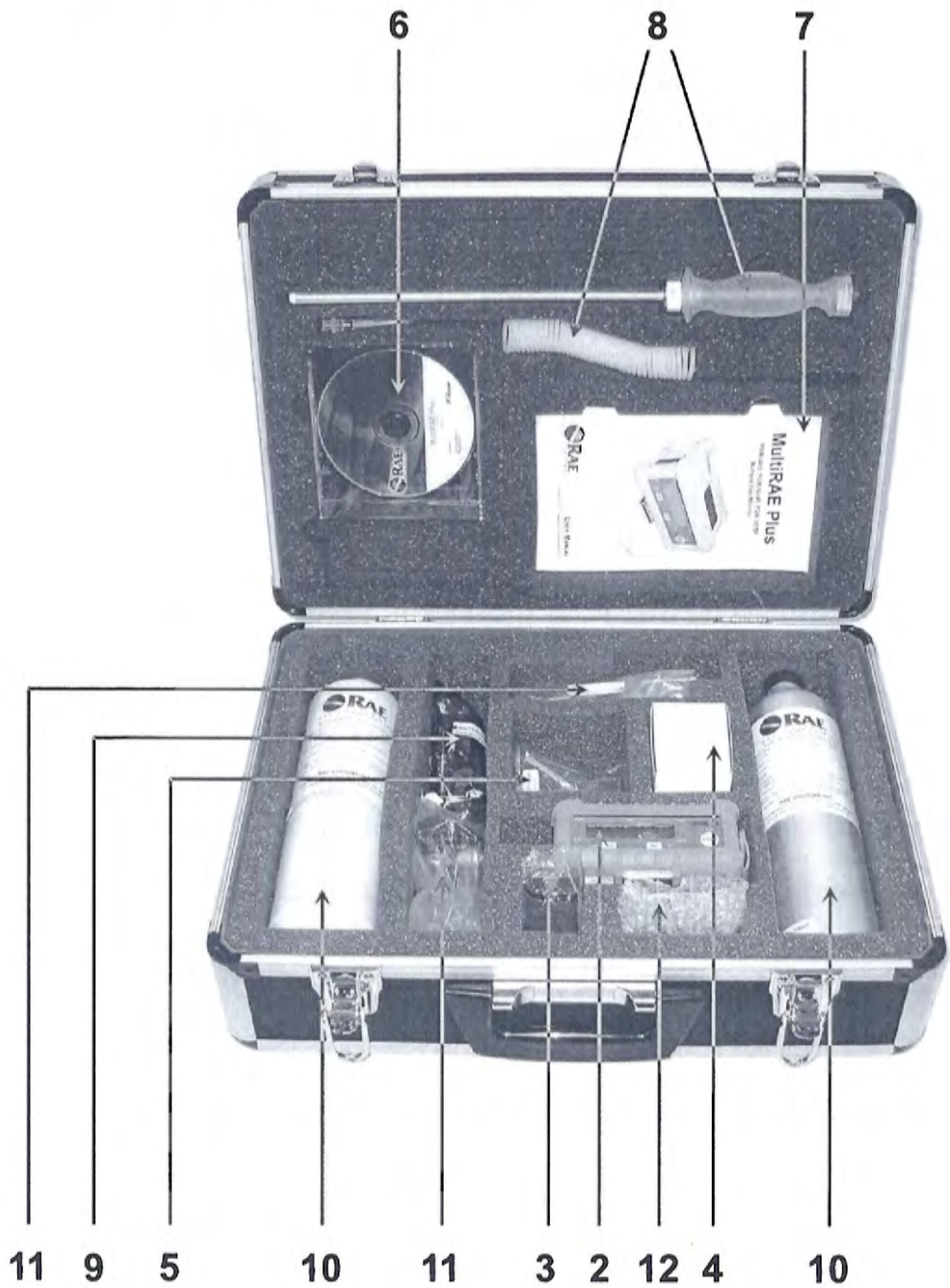
008-4022-000, Revision B1, November 2003

Equipment List

NUMBER	PART	PART NUMBER
	<i>Monitor Only</i>	
(not shown)*	Shipping case	008-3040-000
2	Monitor with wrist strap	<i>as specified</i>
2	Sensors	<i>as specified</i>
2	Rubber boot with belt clip	008-3042-000
2	Rechargeable Li-Ion battery	500-0037-100
3	Alkaline battery adapter	500-0029-000
4	120-230 V AC/DC wall adapter	<i>as specified</i>
5	Calibration adapter	008-3016-000
5	External filters	008-3022-003
5	Inlet probe	008-3012-001
5	Charcoal filters	008-3006-005
6	Training CD	008-4013-000
7	User manual	008-4022-000
	<i>Monitor with Accessories Kit</i>	
1	Hard transport case	002-3009-000
8	Remote sampling probe with coiled Teflon tubing	008-3015-200
9	Tool kit	081-0005-000
	<i>Optional Calibration Kit</i>	<i>008-3001-000</i>
10	Calibration gas	<i>as specified</i>
11	Regulators with tubing (male)	007-3021-000
11	Regulators with tubing (female)	002-3011-000
	<i>Datalogging Upgrade Option</i>	<i>008-001-000</i>
6	ProRAE Suite software package, for Microsoft® Windows™ 95, 98, 2000, NT, ME & XP	000-5001-000
12	Computer interface cable	008-3003-000

*Different shipping cases are used for monitor-only and single calibration gas kits.

This is a complete kit, which includes the accessories and calibration kits with a MultiRAE Plus monitor that is datalog-enabled.



Read Before Operating

This manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions.



Caution!

To reduce the risk of electric shock, turn off power before removing the monitor cover. Disconnect the battery before removing sensor modules for service. Never operate this monitor while the cover is removed. Remove monitor cover and sensor modules only in an area known to be non-hazardous.



Special Note

When the MultiRAE Plus monitor is taken out of the transport case and is turned on for the first time, there may be some residual vapors trapped inside the monitor and the initial toxic gas sensors may indicate a few ppm. After running the monitor for several minutes in clean air, the residual vapors should clear and readings should return to near zero.



Attention! For European Applications

A. CE 0575 Ex II 2G

DEMKO 03 ATEX 0308256X, EEx ia d IIC T3/T4

B. Recharge batteries in non-hazardous locations.

C. Do not connect external cable to serial interface jack in hazardous locations.

D. Use RAE Systems Adapter P/N 500-0072 for connection to communication port and charging jack only in a non hazardous area.

Protected by U.S. Patents 5,393,979 , 5,561,344 ,
5,773,833 , 6,225,633 , 6,313,638 , 6,333,632 , 6,320,388

Warnings

For safety reasons this equipment must be operated and serviced by qualified personnel only. Read and understand the instruction manual completely before operating or servicing.

Battery Pack

Use only RAE Systems battery packs, part number 500-0029 or 500-0037. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous atmospheres.

Computer Interface

Do not transfer data by means of the computer interface cable in hazardous atmospheres.

Static Hazard

Clean only with a damp cloth.

Calibration

The calibration of any newly purchased RAE Systems Instrument should be tested by exposing it to known concentration calibration gases before the instrument is put into service for the first time. For safety, check the accuracy of the monitor by exposing the sensors to known concentration calibration gas(es) before each day's use.

Readings

Any rapid up-scale reading followed by a declining or erratic reading may indicate a gas concentration beyond upper scale limit, which may be hazardous.

Avertissements

Pour des raisons de sécurité, cet équipement doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d'instructions en entier avant d'utiliser, d'entretenir ou de réparer l'équipement.

Ensemble de Batterie

Utiliser seulement l'ensemble de batterie RAE Systems avec numéro de série 500-0029 ou 500-0037. Cet instrument n'a pas été essayé dans une atmosphère de gaz/air explosive ayant une concentration d'oxygène plus élevée que 21%. La substitution de composants peut compromettre la sécurité intrinsèque. Ne charger les batteries que dans l'emplacement désigné non dangereux.

Câble de Computer

Connecter pas le câble externe que dans environnements non dangereux.

Danger Risque D'origine Electrostatique

Nettoyer uniquement avec un chiffon humide.

La Calibration

La calibration de toute instruments de RAE Systems doit être testé en exposant l'instrument à une concentration de gaz connue par une procédure de talonnage avant de mettre en service l'instrument pour la première fois. Pour une sécurité maximale, la sensibilité du MultiRAE Plus doit être vérifié en exposant l'instrument à une concentration de gaz connue par une procédure de talonnage avant chaque utilisation journalière.

Les Lectures

Toute lecture rapide et positive, suivie d'une baisse subite au erratique de la valeur, peut indiquer une concentration de gaz hors gamme de détection qui peut être dangereuse.

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General Information

The MultiRAE Plus is a programmable multiple-gas monitor designed to provide continuous exposure monitoring of toxic organic and inorganic gases, oxygen and combustible gases for workers in hazardous environments.

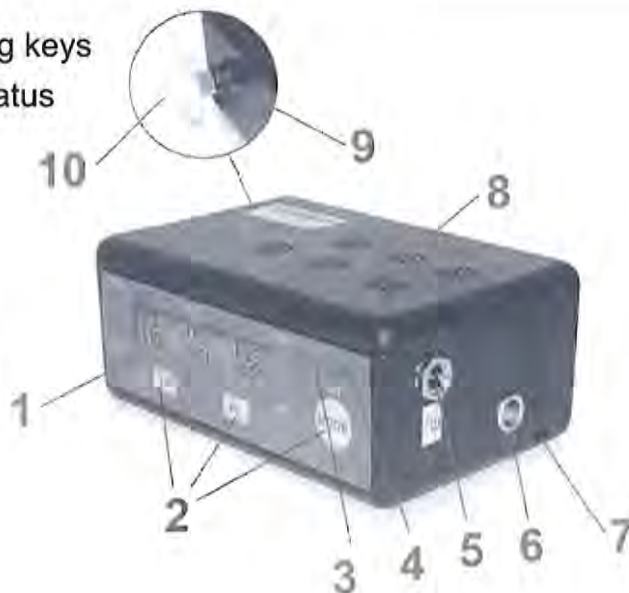
The MultiRAE Plus is an extremely flexible one-to-five sensor instrument for use in confined space, emergency response, industrial hygiene, and many other monitoring applications. The MultiRAE Plus is the only instrument available on the market today that can offer protection using both standard gas detection sensors for the detection of oxygen, combustible gas, and specific toxic gases, as well as an integrated Photoionization Detector (PID) for the ultimate broad-range toxic gas detection. The MultiRAE Plus is easily reconfigured and upgraded to meet your changing needs. Its versatility replaces a wide range of monitors, saving training, and maintenance costs. The MultiRAE Plus transitions quickly and easily from a sophisticated technician instrument to a simple text or display only monitor. The same monitor can be used as a personal monitor, a hand-held sniffer, or as a continuous operational area monitor.

Datalogging-Enabled Monitors

Datalog monitors are capable of storing datalog data in the instrument's non-volatile memory. When the version number appears during the power-on sequence, the "D" indicates a Datalog monitor. Call the factory to learn how to upgrade the instrument to a Datalog monitor.

Physical Description


1. Display
2. Operation/programming keys
3. Visual alarm/charge status
4. Light sensor
5. Power jack
6. RS-232 port
7. Wrist strap holder
8. Buzzer and gas outlet
9. Gas inlet
10. External filter



Operating the MultiRAE Plus

 The external filter must always be used with the monitor.

Turning the Monitor On and Off

To turn on, press . The monitor will beep once and go through a 90-second warm-up sequence as follows:

On! – English, PGM-50

Multi-Gas Monitor, Software Version

RAE Systems, Inc. (customizable using ProRAE Suite software)

Monitor Type, Serial Number

Date, Time, Temperature

Checking Sensor ID's (As the MultiRAE Plus checks each sensor, it displays the date it was last calibrated and its warranty expiration date. If a new sensor is installed, it will ask for it to be calibrated.)

Alarm Limits (for High, Low, STEL, TWA)

Instrument Calibration (The last calibration date must be within the last 30 days for safe operation.)

Battery Shut Off Voltage

User Mode


Alarm Mode

Datalog Memory

Datalog Time Left


Datalog Mode

Datalog Period

To turn off after the warm-up is complete, press and hold  for 5 seconds. The monitor beeps each second during the count-down sequence. Release when "Off!" flashes on the LCD. Plug the 110 VAC/12 VDC transformer into the monitor when not in use; the "Charging....." message appears on the screen.

User Modes

The MultiRAE Plus has three user modes: **Text**, **Display**, and **Advanced**. Each mode provides a different level of access to the monitor's features. Text mode is the simplest mode, Advanced mode is the most complex.

The table shows the features in the order in which they appear. Regardless of which user mode the monitor is in, press  to advance to the next available feature.

Features	Text Mode	Display Mode	Advanced Mode
Sensor Names & Instantaneous Readings - instantaneous readings are the actual gas concentrations for the following sensors: TOX1 (toxic gas) – parts-per-million (ppm) TOX2 (toxic gas) – ppm VOC (volatile organic compound) – ppm LEL (lower explosive limit) – percentage OXY (oxygen) - percentage	yes (with “OK” on LCD)	yes	yes
PEAK - the highest reading for each gas concentration since the monitor was turned on; updated every second.	no	yes	yes
MIN - the lowest reading for each gas concentration since the monitor was turned on; updated every second.	no	yes	yes
STEL - the Short Term Exposure Limit for VOC and toxic gases only; the average reading of the gas concentration for the last 15 minutes, which is updated every minute. NOTE: “*****” will appear for the first fifteen minutes.	no	yes	yes
TWA - the Time Weighted Average for VOC and toxic gases only; the accumulated reading of the gas concentration, divided by 8 hours, since the monitor was turned on. Updated every minute.	no	yes	yes

Battery Voltage - the current battery voltage, measured in volts. Shut off - A fully charged battery will be 4.8 V or greater. When the battery voltage falls below 4.4 V, the "Bat" warning message appears and only 20-30 minutes of run time remain before the instrument will automatically shut down (at 4.2 V).	yes	yes	yes
Date & Time, Run-Time and Temp - the runtime is how long the instrument has been on in hours and minutes.	no	no	yes
Start/Stop Datalog - turns manual datalogging on/off.	no	no	yes
LEL Gas - monitor measures LEL in units of specified target gas. NOTE: Correction factor may only be changed in Program Mode.	no	no	yes
VOC Gas - monitor measures VOC in units of specified target gas. NOTE: Correction factor may only be changed in Program Mode.	no	no	yes
Print Reading - capable of printing out the gas concentration readings if a serial printer is connected to the instrument. NOTE: This feature can be turn on using ProRAE Suite.	no	yes	yes
PC Communication - capable of uploading data from the monitor to a computer or downloading configuration information from a computer to the monitor via a serial port.	yes	yes	yes

Calibrating the Monitor

⚠ While all instruments are calibrated prior to leaving the factory, temperature extremes and/or shocks during shipment can cause sensor drift. Therefore, the accuracy of any newly purchased RAE Systems monitor should be tested by exposing the sensor(s) to known concentration calibration gas before the monitor is used or put into service. For maximum safety, the accuracy of the monitor should be checked by exposing the sensor(s) to known concentration calibration gas before each day's use.

When should you calibrate the monitor?

The monitor should be calibrated no less than every 30 days, or if it does not pass a fresh air reading, or if it does not pass a field verification.

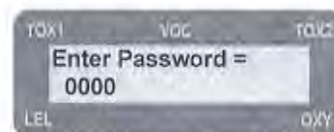
Calibration

The sensors are calibrated in a two-step process using fresh air and span gas (a span gas contains a known concentration of a given gas). Some sensors may show sensitivity to other gases - this is called "cross sensitivity". Therefore, it is important to choose the gas mixture carefully. We recommend the standard RAE Systems MultiRAE Plus 4-gas calibration mix (50% LEL methane, 20.9% oxygen, 25 ppm H₂S, 50 ppm CO in a single gas cylinder) to calibrate the LEL, H₂S and CO sensors, and isobutylene (100 ppm) for the PID. You will also need a calibration adapter in order to connect the monitor (with external filter!) to the outlet of the gas cylinder. For the calibration of other toxic sensors, you will need the specific gas for that sensor.

Getting Started

To calibrate the monitor, the instrument must be in Program Mode. To enter Program Mode, press and hold **MODE** and **N/-** for 5 seconds.

If the monitor is in Text or Display Mode, you will be prompted for a password. Use **Y/+** to change the number. Use **MODE** to move on to the next digit. The default password is "0000". Press and hold **MODE** to submit the password.





Fresh Air Calibration

The first step of calibration is a Fresh Air Calibration:

Calibrate Monitor?

Press **Y/+** .

Fresh Air Calibration?

Press **Y/+** .

The monitor will cycle through each sensor. When the process is complete, the display will read, "Zero Cal Complete!".

Zero Organic Filters for Zeroing PID

Use an optional external zero organic filter (P/N 008-3024-000, 3-pack) when the ambient air may be contaminated with hydrocarbons.

Attach the filter to the MultiRAE Plus during fresh air calibration. The filter can be used up to 20 times before disposing. This filter removes most heavier organic and inorganic compounds, but may not completely remove lighter compounds such as methane, propane, and CO.

Span Gas Calibration

To complete step two of calibration, a Span Gas Calibration must be performed for each sensor.

The instructions below are for a standard confined space entry instrument utilizing CO, H₂S, LEL, Oxygen sensors.

For this calibration you will need the standard RAE Systems MultiRAE Plus 4-gas calibration mix (50% LEL methane, 20.9% oxygen, 25 ppm H₂S, 50 ppm CO in a single gas cylinder). For the calibration of other toxic sensors, or to calibrate a single sensor, please go to the Program Mode section of this manual.

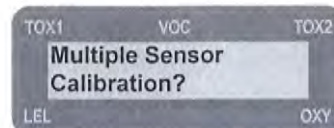
Multiple Sensor Calibration

Press **Y/+** .

The monitor will assume you want to calibrate the CO, H₂S, LEL and Oxygen sensors.

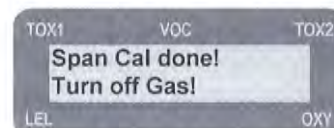
Press **Y/+** .

Apply the RAE Systems 4-gas span gas mixture and start the gas flow.



The 60-second countdown timer appears.

"Span Cal Done! Turn Off Gas" message appears. The readings should be very close to the span gas values shown on the gas cylinder.



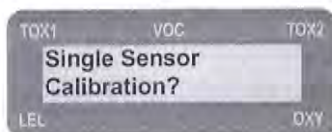
Turn off the gas flow and disconnect the calibration adapter from the monitor. If calibration fails, an error message appears instead. *Refer to Troubleshooting: "Calibration Error Message" on page 38.*

NOTE: If calibration is accidentally started and gas has run out or has been disconnected, press **MODE** repeatedly. Calibration will stop and revert back to the previous calibration values.

Calibrating the PID Sensor

The single sensor method used to calibrate the PID can also be used to calibrate single toxic sensors. For the PID, use isobutylene (100ppm) span gas. For other toxic sensors, use the appropriate gas, e.g., ammonia sensor - use ammonia gas, etc.

Single Sensor Calibration



Press **Y/+**.

When the installed sensors appear on the display use **MODE** to move from sensor to sensor.

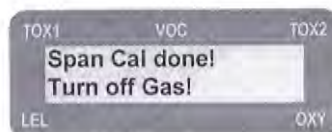
Press **Y/+** to select the highlighted sensor and start calibration.

Apply span gas mixture and start gas flow.

The 60-second countdown timer appears.



NOTE: Some sensors (Cl_2 , PH_3 , NH_3 , HCN) require a special “presoak” period prior to starting calibration. Turn the gas on to the MultiRAE Plus for this time period. **Refer to Range, Resolution and Response Time chart on page 41 BEFORE starting the calibration procedure.** When calibration has started and if the MultiRAE Plus displays “No gas flow...” apply gas or hit any key to start. Press **Y/+** to start calibration.



Calibration is complete when the sensor name and its span value appear, confirmed by a “Span Cal Done! Turn Off Gas” message. If no gas has reached a sensor after sixty seconds, calibration will abort. The readings should be relatively close to the span gas values.

Turn off the gas flow and disconnect the calibration adapter from the monitor. If calibration fails, an error message appears instead. *Refer to Troubleshooting: “Calibration Error Message” on page 38.*

Calibration Time Stamp

A time stamp is created and stored each time a sensor calibration is performed, which is included in the datalog report.

Press **MODE** twice to exit calibration mode and return to the main display.


NOTE: Residual gas may linger on the sensors for up to 60 seconds.

If the sensors do not return to zero, repeat fresh air calibration.

MultiRAE Plus Usage Overview

Storage

Always keep the MultiRAE Plus on charge in a dry indoor area when not in use.

 If the MultiRAE Plus is to be stored more than 2 weeks off the charger, it is recommended to remove the Li-ion battery. Upon reinstalling the battery, it will need a complete charge and some sensors (like NO and NH₃) may require time to warm up, anywhere from 20 minutes to 24 hours. Refer to *Technical Note-114 Sensor Specifications and Cross Sensitivities*. The clock will also need to be reset.

Confined Space Pre-Entry Test

Test the atmosphere in the confined space by sampling air at 3 levels (Top, Middle and Bottom) in the Confined Space. Give the instrument time to sample the gas at each level - the correct sampling time is 60 seconds plus 1 second per every foot of hose.

Alarms

If there are any gas **ALARMS** at any level in the confined space it is not safe. **DO NOT ENTER!**


Identify the alarm condition and then start your preventive actions according to your company's Confined Space Entry procedures.

No Alarms

If there are no alarms, the Confined Space may be safe for entry. Disconnect the hose before carrying the MultiRAE Plus into the Confined Space. If monitoring is to be done by a Confined Space attendant, they should continue to monitor while you enter the area.


If the unit alarms and "BAT" is displayed, the battery needs to be charged. There is 15 minutes or less of run time remaining. **Leave the Confined Space immediately!** See the *Applications and Technical Notes Guide* for more information regarding Confined Space Entry and other applications.

After Usage

Turn the MultiRAE Plus off by pressing and holding . The buzzer will beep and count down 5-4-3-2-1 and read "OFF". Return the MultiRAE Plus to the dry, indoor storage area and connect the charger to the MultiRAE Plus.


Alarm Signals

When an alarm condition occurs, the monitor will provide audible and visual alarms to alert users of unsafe conditions. *Refer to the Alarm Signals table on page 11 for a complete list of alarm conditions.*


 The alarm signals are disabled while in the following modes: **Communicate with PC, Print Reading, Calibrate Monitor**. To reduce the risk of exposure to hazardous atmospheres, use these modes only in an area known to be non-hazardous.



The alarm system can be set up in one of two ways:

Auto Reset Alarm (default): The alarm signals automatically reset when the alarm condition is no longer present. **NOTE:** Not all alarm conditions have this option.

Latched Alarm: The alarm signal remains on even when the alarm condition is no longer present; press  to acknowledge and reset alarm signals.

Testing Alarm Signals

Press  . If functional, the buzzer will beep once and the backlight will flash once.

Alarm Condition	Alarm Signal			Screen Message	Reset Alarm
	beep/sec	flash/sec	vibration*		
Gas concentration exceeds High Alarm	3	3	yes	sensor name "HIGH"	move away from gas
Gas concentration exceeds Low Alarm	2	2	yes	sensor name "LOW"	move away from gas
Gas concentration exceeds STEL	1	1	yes	sensor name "STEL"	move away from gas & wait 15 minutes
Gas concentration exceeds TWA	1	1	yes	sensor name "TWA"	move away from gas & turn unit OFF/ON
Gas concentration exceeds sensor range	3	3	yes	sensor name "OVR"	move away from gas
Unit short circuits <i>or</i> Reading over max range	3	3	yes	sensor name "MAX"	indicates possible sensor failure. calibrate sensor to verify performance
Excessive sensor negative drift	1	1	yes	sensor name "NEG"	perform zero calibration
Blocked inlet <i>or</i> Pump failure	3	3	yes	"PUMP"	unblock inlet; press  to restart pump
PID lamp fails to light	3	3	yes	"LAMP"	turn off/on or wait; lamp may turn on by itself
Excessive LEL gas <i>or</i> LEL sensor is OFF	3	3	yes	sensor name "OFF"	move away from gas & turn LEL sensor ON (press )
Low battery	1/min	1/min	no	"Bat"	charge battery
Datalog memory full	1	1	yes	"Mem"	clear datalog memory or turn on "wrap-around"
Datalog memory write error	1	1	yes	"EEem"	turn unit OFF/ON

*The external vibration alarm is an optional feature.

Preset Alarm Limits and Calibration


The monitor is factory calibrated with standard calibration gas and is programmed with default alarm limits as listed:

Gas	Cal Gas/Balance	Unit	TWA	STEL	Low	High
CO	50/Air	ppm	35	100	35	200
H ₂ S	25/N ₂	ppm	10	15	10	20
SO ₂	5/N ₂	ppm	2	5	2	10
NO	25/N ₂	ppm	25	25	25	50
NO ₂	5/Air	ppm	1	1	1	10
Cl ₂	10/N ₂	ppm	0.5	1	0.5	5
O ₂	20.9/N ₂	%Vol	-	-	19.5	23.5
CH ₄	50/Air	%LEL	-	-	10	20
HCN	10/N ₂	ppm	5	5	5	50
NH ₃	50/N ₂	ppm	25	35	25	50
PH ₃	5/N ₂	ppm	0.3	1	1	2
VOC*	100/Air	ppm	10.0	25.0	50.0	100

*Note: 100 ppm isobutylene gas is used for VOC gas calibration

Back Light


The backlight assists reading the LCD in poor lighting conditions and automatically turns on anytime the MultiRAE Plus is in alarm.

To manually turn on, press , and it will automatically turn off after 60 seconds. The backlight can also be set to automatically turn on in low lighting conditions, and likewise turn off in adequate lighting conditions.

NOTE: The backlight can shorten the operating time by 20-30%.

Sampling Pump

The integrated sampling pump automatically turns on when the monitor is turned on and remains on during normal operation. The pump speed is adjustable between the default low setting (~200 cc/min) and the high setting (~300 cc/min). Use the low setting to save battery and filter life. Use the high setting for reactive gases and remote sampling in applications like Wingtank entry and HazMat.

The monitor can detect any obstructions in the external filter that causes a pump stall. The alarm will activate and a “Pump” error message will appear. To acknowledge the pump stall, press  to start the pump again.

Refer to Pump Stall on page 29 for details on how to adjust the pump stall threshold for either the high or low settings.

Datalogging

A small “L” at the center of the screen means the monitor is datalogging. Datalogging-enabled monitors can calculate and store hours of gas readings based on the time-interval and type of gas measurement specified. The time-interval can be set to between 1 and 3600 seconds in 1-second increments. The average and peak gas concentrations are the two types of gas measurements that can be stored for each sensor. **NOTE:** STEL and TWA values will only be logged if average is selected. All data is stored in non-volatile memory that can be downloaded to a computer. Users may select one of two types of memory storage: wrap-around or stop. *Refer to Select Memory Full Type on page 23.*


NOTE: Datalogging pauses upon entering Program Mode or PC Communication Standby Mode. Upon exiting Program Mode datalogging will resume. Upon exiting PC Communication Standby Mode, datalogging will resume only if datalogging mode was set to “Automatic”.

Maximum Datalog Time for 5 Sensors

Log Interval	1 sec	60 sec	300 sec (5 min)
Tmax	80 minutes	80 hours	400 hours

Datalog Options

Automatic: Datalogging automatically starts/stops when the monitor is turned on/off.

Manual: If the MultiRAE Plus is in Advanced mode, press  at the “Start Datalog” screen. Set a timer to specify the maximum datalogging time using ProRAE Suite software.

Periodic: Set a daily start/stop time to datalog using ProRAE Suite.

Scheduled: Set a monthly start/stop time to datalog using ProRAE Suite.


Charging the Battery Pack

To charge the battery pack plug the transformer supplied with the monitor into the power jack on the monitor.

When a Li-Ion battery pack is installed, charging automatically begins. The LED appears red during charging, and once the battery is fully charged, the LED turns green. The display also indicates the charge status. A completely drained battery pack charges to full capacity in less than 10 hours. When the "Bat" message appears on the LCD, the battery pack needs to be recharged.

NOTE: A fully charged battery pack will switch to trickle charge to maintain battery life. Repeatedly turning the power to the transformer on and off will reset the charge and possibly burn out the battery.

To change the battery pack or to use the alkaline battery adapter, *refer to Replacing the Battery Pack or Emergency Alkaline Battery Adapter on page 32.*

 **If the MultiRAE Plus is to be stored more than 2 weeks off the charger, it is recommended to remove the Li-ion battery.**

Accessories

External Filters

The external filter is a PTFE (Teflon®) membrane with a 0.2 micron pore that reduces the amount of liquid and dust that can contaminate the sensor. Using the external filter prolongs sensor and pump life.

Change the external filter whenever it becomes discolored, clogged with particles, or draws in liquid.

NOTE: Do not use the external filter when calibrating reactive gases. Instead, use the High Pump Speed setting and a short Teflon® tube. Although this shortens battery life, it provides a faster response.


Remote Sampling Probe

When searching in hard-to-reach areas, use the standard remote sampling probe (P/N 008-3015-200) with a telescoping handle and 6 feet of Teflon tubing. For longer distances, attach a length of Teflon tubing. The monitor is capable of drawing samples from over 100 feet.



Optional Dilution Fitting

When gas samples have less than 10% oxygen, the dilution fitting (P/N 008-3025/3026) will increase the oxygen concentration. The dilution fitting can also measure combustible, VOC or toxic gases when the concentration exceeds the upper limit of the sensor range. In Program Mode, set the dilution ratio to obtain the correct gas reading when the dilution fitting is used. The dilution fitting attaches directly to the meter and the sample tubing attaches to the dilution fitting. *Refer to Technical Note-167 Proper Use of Dilution Fittings on Pumped Monitors for more information.*

 **The monitor and the dilution air inlet must be located in a clean atmosphere outside the confined space. Use either a remote sampling probe or Tygon tube test gas samples.**

Calibration Adapter

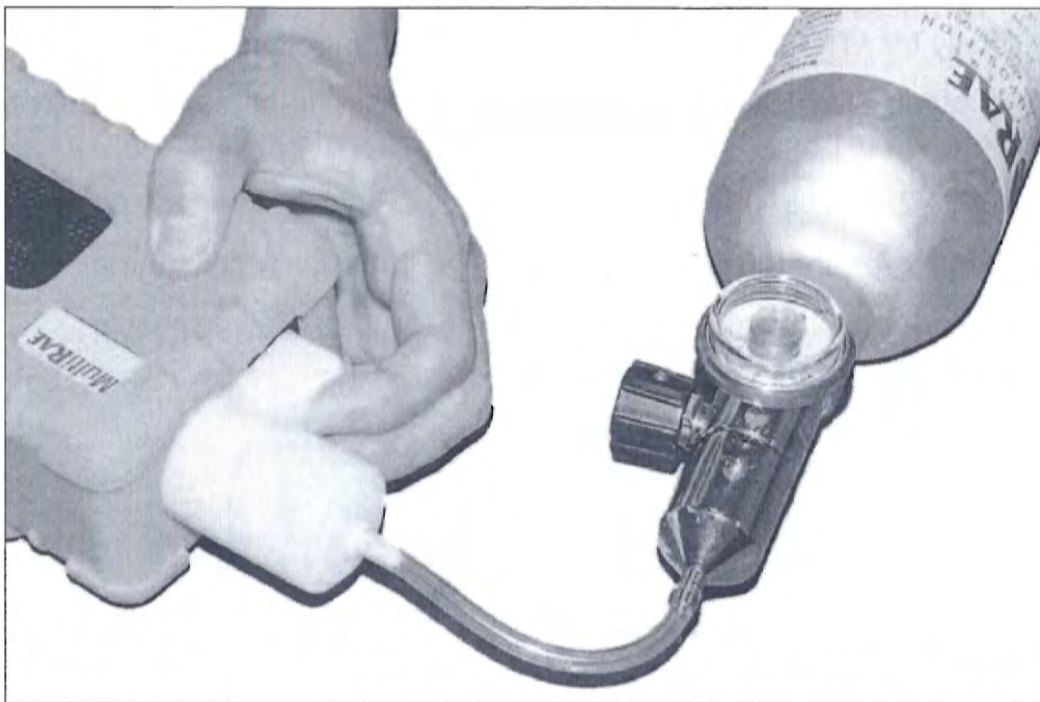
The calibration adapter is a 6-inch Tygon tube with a male Luer connector on the end. During calibration, connect one end of the tube to the external filter (on the monitor) and the other end to the calibration gas.



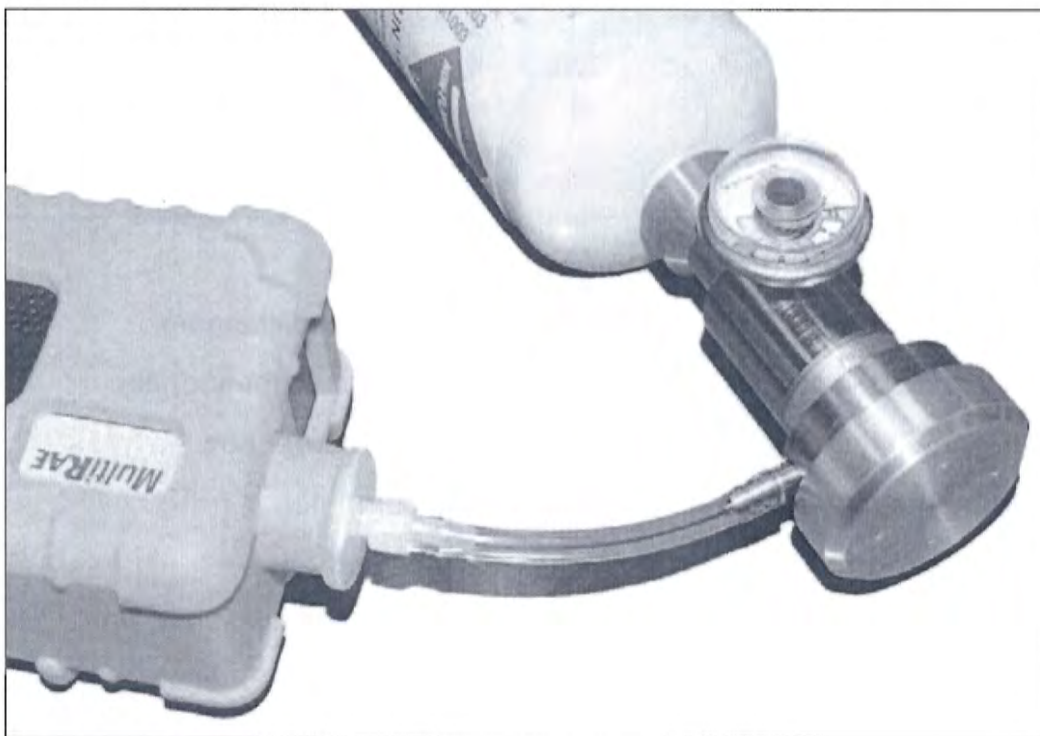
Alternatively, the calibration gas can be sampled from:
an optional **Tedlar gas bag** (P/N 500-0003-000) filled with calibration gas,



an optional **open cup** (P/N 007-3002-000) with calibration gas flow exceeding the pump demand,



or an optional **demand flow regulator** (P/N 002-3051-000, female or P/N 008-3052-000, male) directly from the gas cylinder.

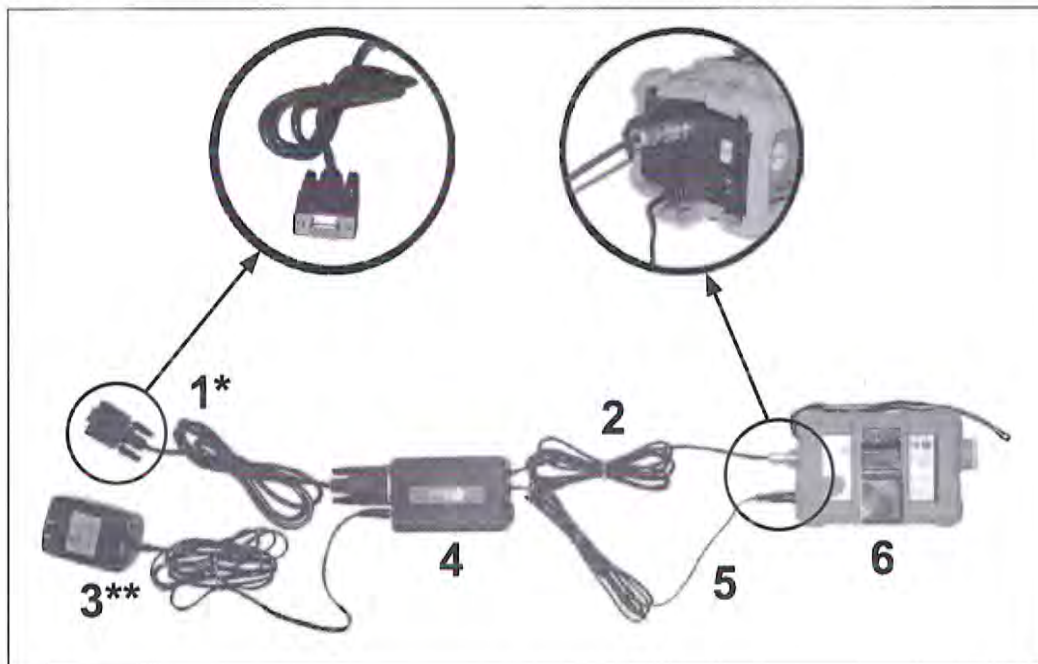


Using the Intrinsically Safe Barrier Box

⚠ This does NOT ship with UL/cUL-approved monitors. The barrier box is only for ATEX European approved MultiRAE monitors.

To conform to ATEX European safety standard, the barrier box **must be used** when utilizing an RS-232 cable and/or transformer.

- | | |
|-------------------------------|-------------------------------|
| 1. RS-232 cable (detachable)* | 2. Computer interface cable |
| 3. Transformer (detachable)** | 4. Intrinsically safe barrier |
| 5. Power cable | 6. MultiRAE Plus monitor |



Communicating with a Computer

*** This connection is not necessary during normal charging.**

Connect the RS-232 cable from the barrier box to the monitor.

Connect the computer interface cable to the barrier box.

Plug the computer interface cable into a computer.

Charging the Monitor

**** Connection is optional during computer communication.**

Connect the power cable from the barrier box to the monitor.




Connect the transformer to the barrier box.



Plug the transformer into an appropriate outlet.

Programming Mode

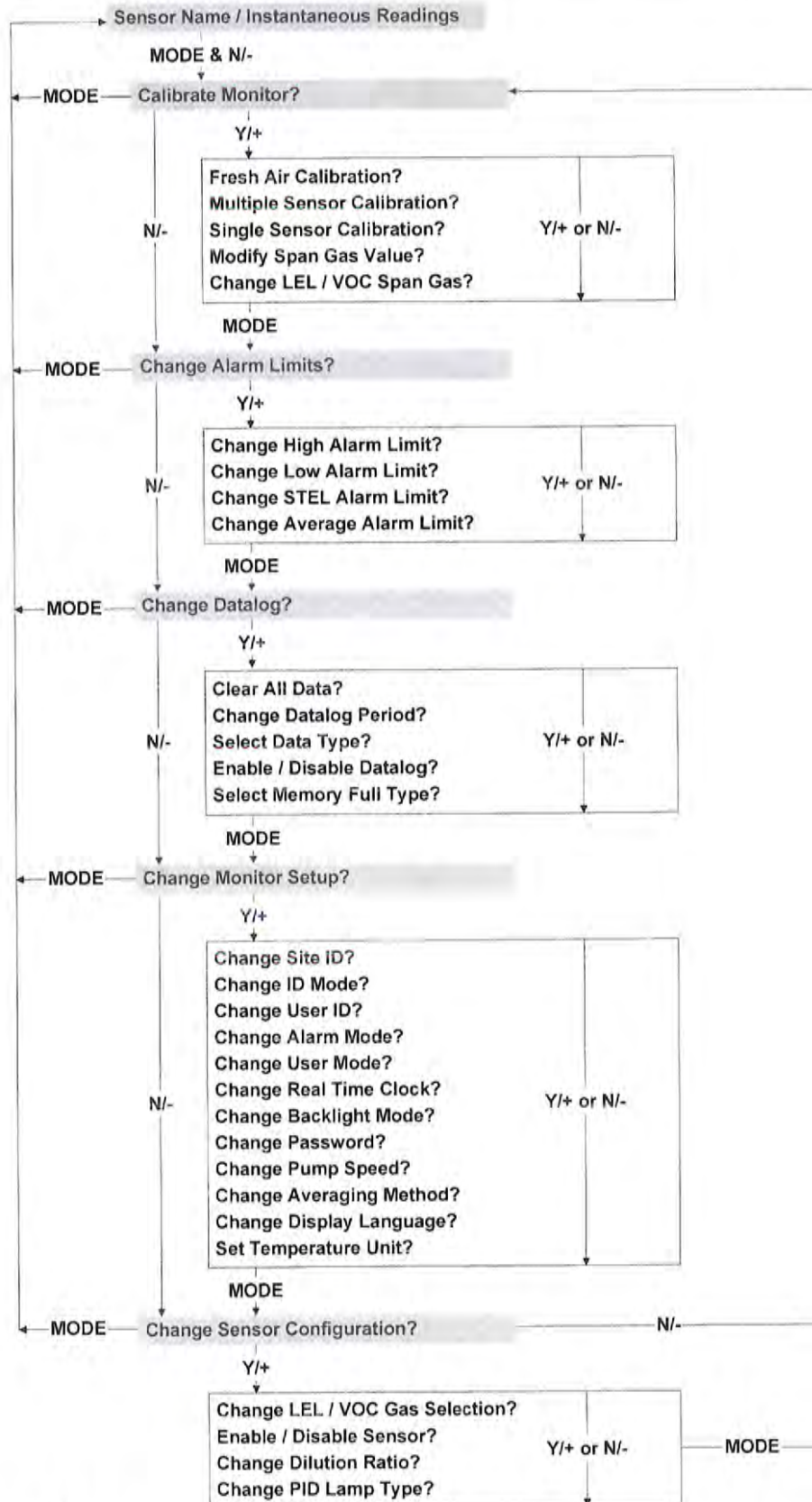
In addition to calibration, authorized users may change the monitor settings to their requirements using the Programming Mode.

NOTE: Monitoring gas concentrations continues during Programming Mode, but pauses during Calibration. Datalogging also pauses during Programming Mode, but resumes when programming is finished.

Press 	for desired menu to answer "no" to decrease a digit
Press 	for desired submenu to answer "yes" to increase a digit
Press 	to return to the sensor name/ instantaneous reading display to exit a submenu to advance digits

To enter the Program Mode, press  and  together until the first program menu appears: "Calibrate Monitor?" *Refer to Getting Started on page 5.* The figure on the following page summarizes the programming menus and how to navigate through them.

Programming Menus



Security Levels

Security levels are setup via computer using ProRAE Suite. The default password is: 0000. **NOTE:** For security purposes "0000" always appears instead of actual password.

No changes will be saved unless the user is in the correct mode with the correct security level.

User Mode	Text			Display			Advanced		
Security Level	0	1	2	0	1	2	0	1	2
Calibrate Monitor?	.								
Fresh Air Calibration?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Multiple Sensor Calibration?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Single Sensor Calibration?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Modify Span Gas Value?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change LEL/VOC Span Gas?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Alarm?									
Change High Alarm Limit?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Low Alarm Limit?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change STEL Alarm Limit?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Average Alarm Limit?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Datalog?									
Clear All Data?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Change Datalog Period?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Select Data Type?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Enable/Disable Datalog?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Select Memory Full Type?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Change Monitor Setup?									
Change Site ID?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Change ID Mode?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Change User ID?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Change Alarm Mode?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Alarm Mode?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change User Mode?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Real Time Clock?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Backlight Mode?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Change Password?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Pump Speed?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Averaging Method?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Display Language?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Set Temperature Unit?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change Sensor Configuration?									
Change LEL/VOC Gas Selection?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Enable/Disable Sensor?	✓*	✓*	✓*	✓*	✓*	✓*	✓	✓*	✓
Change Dilution Ratio?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓
Change PID Lamp Type?	✓**	✓*	✓*	✓**	✓*	✓*	✓#	✓*	✓

* Need password

No change allowed

Calibrate Monitor

Fresh Air Calibration? *Refer to Calibrating the Monitor on page 5.*

Multiple Sensor Calibration? *Refer to Calibrating the Monitor.*

Single Sensor Calibration? *Refer to Calibrating the Monitor.*

Oxygen Sensor Calibration: The oxygen sensor calibration is slightly different from other sensors; span calibration at 20.9% O₂ is performed during fresh air calibration. During single sensor calibration, the oxygen sensor can be calibrated to 0% O₂ with pure nitrogen gas, by pressing **Y/+** when asked "0%? Oxygen?" To calibrate at a different concentration specified in Modify Span Gas Value, press **N/-**.

NOTE: After a single sensor oxygen calibration, perform fresh air calibration to ensure the oxygen sensor is calibrated correctly.

Modify Span Gas Value?

The span gas is the second point of reference for calibration. Users may modify the span values of the standard calibration gases to use other calibration gases. However, DO NOT modify the span values when using the RAE Systems calibration gas supplied with the monitor.

Change LEL/VOC Span Gas?

Change the type of calibration gas from methane (LEL) and isobutylene (VOC) to be used as the span gas during LEL or VOC gas calibration. However, DO NOT modify the span gases when using the RAE Systems calibration gas supplied with the monitor.

Change Alarm Limits

Users may change the alarm limits for each sensor. Use **N/-** to cycle through the submenu options. Press **Y/+** to enter a submenu. To modify the limit, use **Y/+** and **N/-** to change the value. Use **MODE** to move from character to character.

To escape the submenu without saving changes, press **MODE**. To save, press **MODE** until "Save?" appears. Press **Y/+** to save changes, otherwise press **N/-** to discard changes.

Change High Alarm Limit?

Change Low Alarm Limit?

Change STEL Alarm Limit? (Short Term Exposure Limit)

Change Average Alarm Limit? (TWA – Time Weighted Average)

Change Datalog Setting

The monitor calculates and stores the gas readings at specified intervals, which can be reviewed by the user. Users may also program additional datalog options for the monitor through the computer.

Clear All Data?

Erase all data stored in the non-volatile memory, but does not delete the PEAK, MIN, STEL, TWA displayed values, which are stored separately.







Change Datalog Period?

Program the datalog period from 1 second to an hour (3,600 seconds).

Select Data Type?

Store either the average (TWA) or peak value for each datalog interval. If peak values are selected, average values like STEL and TWA will not be selected.

Enable/Disable Datalog?

Enable or disable the datalogging function for each sensor. If a * is displayed next to a sensor name, data will be recorded. Use  to move from sensor to sensor. An asterisk (*) means the sensor is enabled; no asterisk means the sensor is disabled. Press  to select or press  to deselect. To save changes, press  until "Save?" appears. Then press  to accept. Otherwise, hold  to escape and cancel changes.

Select Memory Full Type?

The instrument's memory can store about 3 days' worth of data, as a result of continuous monitoring at 1-minute intervals. Users may select one of two types of memory storage:

Wrap-around: after the memory becomes full, the latest data overwrites the oldest data. e.g. the most recent 3 days' worth of data is stored.

Stop: halts datalogging when the memory is full, and the "MEM" alarm sounds. e.g. the first 3 days' worth of data is stored.

Change Monitor Setup

Change the monitor setup or enter user information for the monitor. Use **MODE** to move the cursor from character to character. Use **Y/+** and **N/-** to toggle up and down the alphabet and numbers. To save, press **MODE** until "Save?" appears. Press **Y/+** to save changes, otherwise, press **N/-** to discard changes. To escape this menu without saving changes, press and hold **MODE**.

Change Site ID?

Enter an eight-character alphanumeric site identification, which is included in datalog reports.

Change ID Mode?

Set up an identification code to use during start-up or to access a previously saved customized ID.

Change User ID?

Enter an eight-character alphanumeric user identification, which is included in datalog reports.

Change Alarm Mode?

Choose either latched or automatic reset. The user must manually acknowledge a latched alarm by pressing **Y/+**.

Change User Mode?

The three different user modes are: Text, Display and Advanced.

Change Real Time Clock?

Change or update the real time clock and calendar.

Change Back Light Mode?

Automatic – the monitor turns the back light on/off when ambient light falls below/above the threshold or **Manual** – press **N/-** to turn the back light on/off.

Change Password?

Modify the password.

Change Pump Speed?

Low – (default) use when operating conditions are slow to change; prolongs pump motor life, LEL sensor life and battery run time.

High – use for long lengths of tubing or when rapid changes in input conditions are expected, such as HazMat response or when used for measuring heavy, low vapor pressure compounds like jet fuel.

Change Averaging Method?

Choose: **TWA** (default) – an eight-hour Time Weighted Average or **AVG** – the running average

Change Display Language?

Choose English or Spanish.

Set Temperature Unit?







Choose Celsius or Fahrenheit to measure temperature.

Change Sensor Configuration

Change LEL/VOC Gas Selection?

Choose an LEL or VOC gas listed in the monitor to calculate its correction factor relative to the LEL or VOC calibration gas. *Refer to Correction Factors on page 26.* The correction factor allows the unit to display the equivalent concentration of the selected LEL or VOC gas. To create a custom factor for a specific gas or mixture of gases, modify the relative correction factor to increase or decrease the gas reading.

Enable/Disable Sensor?

Enable or disable sensor(s); a disabled sensor will not measure or display the gas concentration. Use if a sensor has failed or is providing erroneous readings. Use  to move from sensor to sensor. An asterisk (*) means the sensor is enabled; likewise, no (*) means the sensor is disabled. Press  to select or press  to deselect. To save changes, press  until "Save?" appears. Then press  to accept. Otherwise, hold  to escape and cancel changes.

Change Dilution Ratio?

Attach an optional dilution fitting on the gas inlet port to dilute the gas sample. Enter a dilution ratio (from 1 to 10) to compensate the reading for the actual gas concentration.

Change PID Lamp Type?

This only applies to PID monitors. The PID sensor can utilize either a 10.6 eV or an 11.7eV UV. Since each lamp type has a different correction factor table, it is important to select the correct lamp type.

Correction Factors

VOC and LEL sensors respond to a broad range of gases and show a different sensitivity to different gases; correction factors allow measurement of a specific gas (the measurement gas) while using a different gas for calibration (the calibration gas). The correction factor (CF) for a measurement gas is defined as:

$$\text{CF} = \text{Sensitivity to a Calibration Gas} \div \text{Sensitivity to a Measurement Gas}$$

To convert the monitor reading of the calibration gas to the true concentration of a measurement gas, use the following equation:

$$\text{True Concentration (ppm)} = \text{CF} \times \text{Monitor Reading (ppm)}$$

The monitor has three sets of correction factors, one for the LEL and two for the VOC (10.6 eV and 11.7 eV) Each set consists of 20 to 40 different gases. Specify the PID lamp type (e.g. 10.6 eV or 11.7 eV) to access the proper VOC correction factor.


To set up a correction factor, first choose a calibration gas in the Calibrate Monitor program menu and then choose a measurement gas in the Change Sensor Configuration menu. If the calibration gas is different from methane for LEL or isobutylene for PID, then the new CF is calculated and the displayed value will be different from the values in Technical Notes 106 or 156.

NOTE: Correction factors provide an estimate of the measurement gas concentration. For greatest accuracy, it is necessary to calibrate the LEL or VOC sensor directly with the measurement gas.



Refer to Technical Note-106 Correction Factors and/or Technical Note-156 LEL Correction Factors.


Diagnostic Mode

The monitor is equipped with a diagnostic mode that can display critical, low level parameters to help users identify problems. *Refer to Troubleshooting on page 38.*

 **The diagnostic mode allows the user to set several low level parameters which are very critical to the operation of the monitor. Extra care should be taken when setting these low level parameters. If the user is unfamiliar with these parameters and sets them incorrectly, it may cause the monitor to shut down or malfunction. The diagnostic mode should only be used by qualified personnel.**

To switch the monitor to diagnostic mode, turn the monitor off.

Press and hold  and  together; release both keys when the unit beeps. The monitor is now in diagnostic mode.

Press  until the desired diagnostic parameter appears:

Sensor Name and Raw Sensor Readings

If a sensor is programmed and is properly installed, the sensor name should appear. If the sensor name does not appear, then the sensor may be improperly programmed or defective. The raw sensor reading is the uncalibrated output for each sensor. When fresh air is applied, the raw sensor readings should be 200 to 700 for toxic gas and VOC sensors; 100 to 1300 for the LEL sensor; and 1200 to 2300 for the oxygen sensor. When calibration gas is applied, the raw sensor readings should increase or decrease by the amounts listed in Technical Note - 123 Special Diagnostic Modes. If the raw sensor readings are outside the normal range or do not change when gas is applied, the sensor or monitor may be defective.

RF Test (Radio Frequency)


This feature applies when the monitor is used with the RAELink Remote package. The RF test shows the successful rate of communication.



Adjust Lamp Failure Threshold

If the lamp physically appears fine, but the "Lamp" error message appears during normal operation, the lamp failure threshold may be set too high.

To adjust the level:

Turn the monitor on in diagnostic mode and go to the "Lamp = xxx, Fail = yyy +/-" display. ("xxx" is the lamp current reading; "yyy" is the value of the lamp failure threshold.)

Decrease the "yyy" value until it is about 10 counts below the "xxx" value. Press  to exit.

Then press  to save changes, or press  to discard changes.

Battery Type and Bias

The type of battery (Lithium-Ion battery pack or alkaline battery adapter) used to charge the monitor is displayed. Some toxic gas sensors require a bias voltage of a few hundred millivolts for the sensor to function properly. These include NO and NH₃ sensors.




To manually switch the bias voltage supply on, *refer to Special Bias Voltage for Toxic Sensors on page 35.*

Install a biased sensor in the TOX1 socket. If the bias voltage is switched on, the bias reading should be below 182, otherwise it may be defective.



Show x1 and x10 Range of PID Sensor (PID detectors only)

The PID sensor is connected to two amplifiers with two different gains: unity gain and gain of ten; these are the raw outputs of both amplifiers. When fresh air is applied, both amplifier outputs should be 200 to 500. When a VOC gas is applied, both amplifier outputs should increase; the amount of increase for the unity gain (x1) should be 1/10 of the increase for the gain of ten (x10). If the increase does not agree with the expected value, then the gain switch of the amplifier may be defective.

Display Contrast

Press  to increase the contrast and  to decrease the contrast. The LCD contrast bar indicates the current setting. If the display appears to have dark lines, press  a few times to see the display more clearly. **NOTE:** In extreme temperatures, the display may fade or bleed out.

LEL Power

The top line indicates the instantaneous reading of raw counts from the LEL sensor. The bottom line shows if the LEL sensor is on or off. Press  to turn the power off, and press  to turn the power on.

Clock, Time, Battery, and Temperature

This display shows the real time clock, the date, the battery voltage in raw count and temperature sensor reading.

Sensor Expiration Date

The expiration date (month and year) for each installed sensor is based on the manufacturing date and expected life of each sensor. If the current date exceeds the expiration date for any sensor, the performance of the given sensor cannot be guaranteed. It is strongly recommended to replace the sensor immediately to ensure proper operation.

Pump Stall

The “Pump = 20/20” reading is the minimum and maximum pump raw count (RC), and “Stall = 40 +/-” is the pump stall threshold. The pump stalls if the maximum raw count reaches the pump stall threshold, which causes the pump to shut off. To determine the pump stall threshold:

$$[(\text{max RC when pump is free} + \text{max RC when pump is blocked})] \div 2$$

To adjust the pump stall threshold, press **Y/+** to increase or **N/-** to decrease the numerical value.

Back Light Threshold

Adjust the threshold for the LCD backlight to automatically turn on/off; verify the threshold is 100, which is suitable for most situations.

Serial Number and Pump

Displays the monitor’s serial number and the pump status. If a pump is installed and a pump speed control circuit is available, toggle the display “Pump=Low/High” by pressing **N/-**. **NOTE:** Changes made are only for testing the pump condition and are not saved to the nonvolatile memory. *Refer to Change Pump Speed on page 25.*


Battery Duration Time

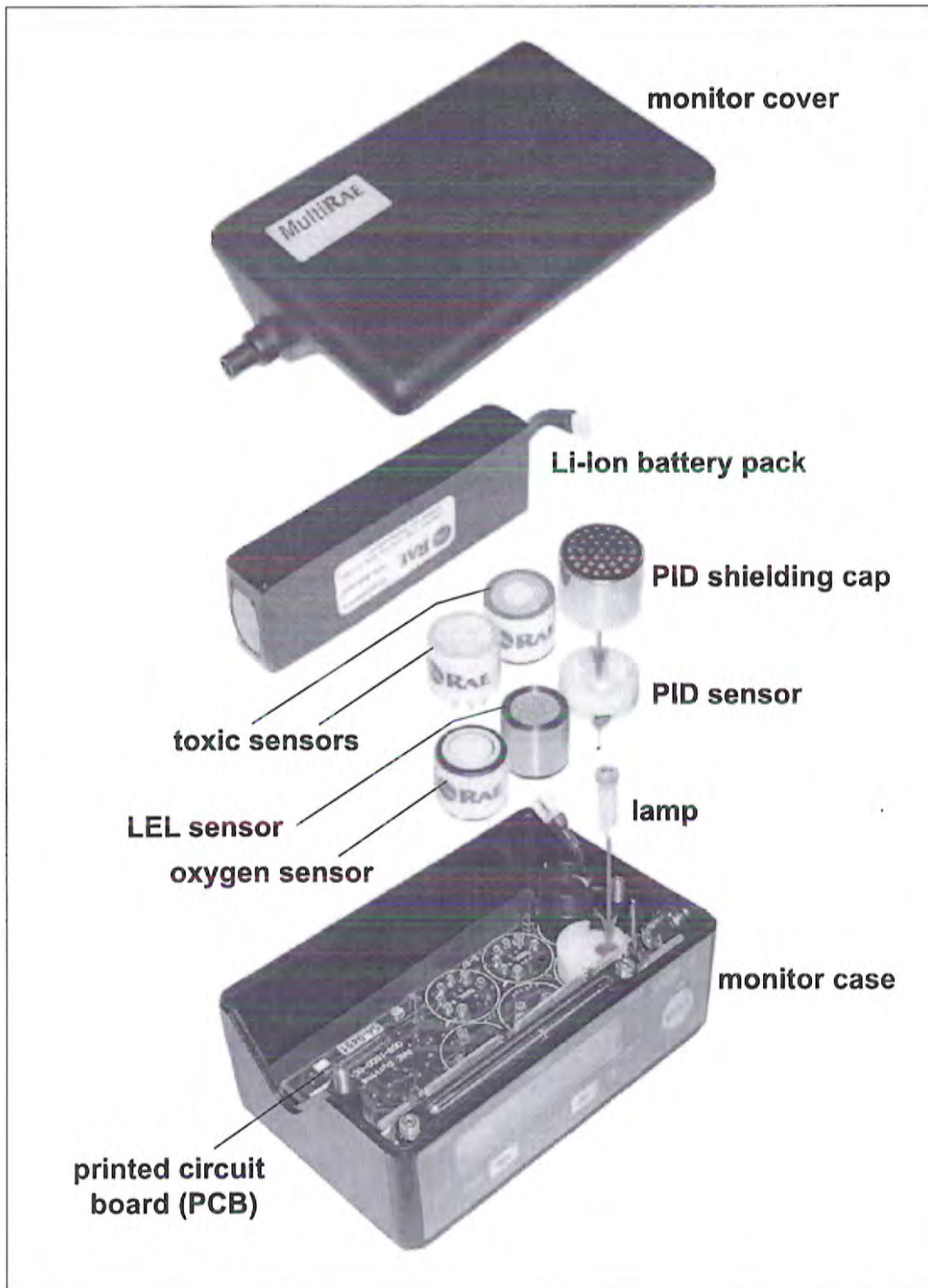
Use to test battery life and displays the last run time before the unit turned itself off due to low battery.

Communicate with PC

Connect monitor to a personal computer to upload a configuration file or download stored data.

Maintenance

 Power from the battery is flowing to the printed circuit board (PCB) and sensors even when the power is off. Therefore, it is very important to disconnect the battery pack before servicing or replacing sensors or any components inside the monitor. Severe damage to the PCB may occur if the battery pack is not disconnected before servicing the unit.



Li-Ion Battery Pack

The factory supplied Li-Ion battery pack is designed to last for 10 hours of normal operation (without alarm or backlight conditions). The rechargeable batteries have a 1-year warranty. Age, ambient temperature, and heavy useage may impact battery life. Battery packs will slowly drain even if the monitor is turned off. If the battery packs have not been charged for 10 days, the battery voltage will be low. It is recommended to fully charge the battery packs before going into the field, and recharge the battery pack upon returning from the field.

⚠ To reduce the risk of ignition of hazardous atmospheres, recharge battery only in areas known to be non-hazardous. Remove and replace battery only in areas known to be non-hazardous. Ne charger les batteries que dans emplacements désignés non dangereux.

Replacing the Battery Pack

⚠ To reduce the risk of ignition of hazardous atmospheres, recharge battery only in areas known to be non-hazardous. Remove and replace battery only in areas known to be non-hazardous. Ne charger les batteries que dans emplacements désignés non dangereux.

Remove the monitor cover by loosening the two case screws, and then unplug the battery pack from the battery jack.

Place a fully charged spare battery pack into the monitor.

Make sure the battery plug is connected securely.

Reattach the cover and tighten the screws.



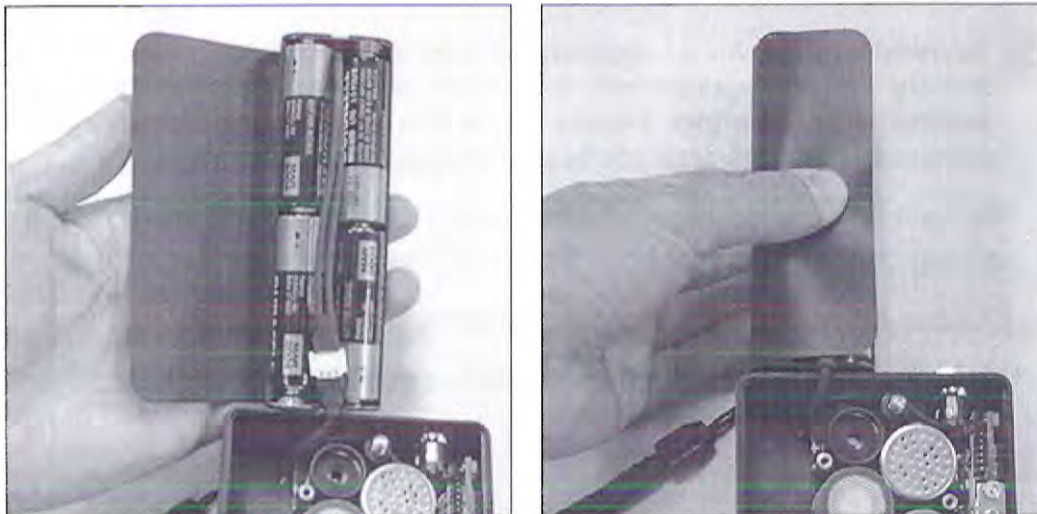
Emergency Alkaline Battery Adapter

⚠ The alkaline battery adapter supplied by RAE Systems is intrinsically safe. The adapter is intended to be used in emergency situations when there is no time to recharge the Li-Ion battery pack. The adapter accepts 4-AA alkaline batteries to provide approximately 12-14 hours of operation.

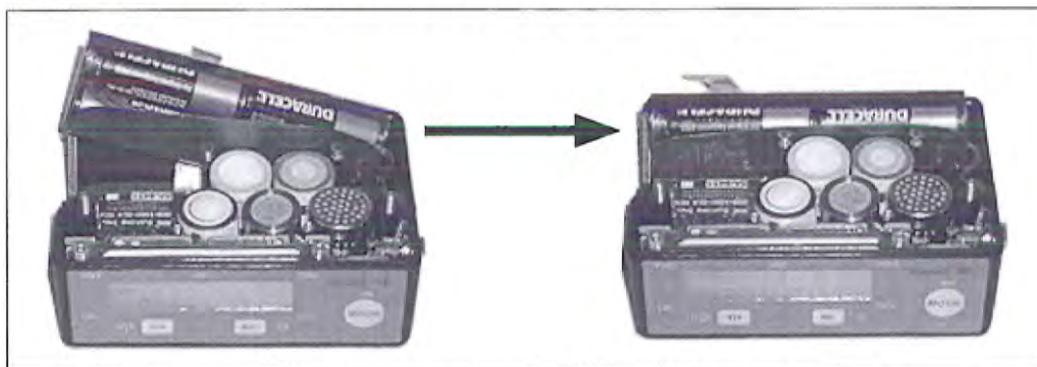
To install the adapter, remove the monitor cover. Remove the Li-Ion battery pack from the monitor by carefully disconnecting the wires.

Install four AA alkaline batteries into the battery adapter, making sure the battery polarity is correct.

Connect the battery adapter to the monitor. Make sure the wires are placed inside the adapter, running between the batteries. Close the flap over.



Install the battery adapter in the monitor.



The monitor automatically detects the alkaline batteries and will run for 8-10 hours. Use the monitor once the alkaline battery adapter is installed. Replace the alkaline batteries when spent.

Sensor Replacement

Under normal operating conditions, most sensors will lose their original sensitivity after the expected operating life and eventually need to be replaced. Each sensor has a non-volatile memory that has the manufacturing and expiration dates, which appear during the warm-up period or can be looked up in the diagnostic mode.

Warranties: Oxygen (O₂), combustible gas (LEL), hydrogen sulfide (H₂S) and carbon monoxide (CO) sensors all have a 2-year warranty. All other toxic sensors have a 1-year warranty.

NOTE: The Oxygen and the LEL sensors have assigned sockets. These are identified on the PCB. High bias toxic sensors should be installed in socket 1/A. *Refer to Special Bias Voltage for Toxic Sensors on page 35.* Any toxic sensor can be installed in socket 2/B.

Replace the sensor when it fails to calibrate.

To replace sensor(s), turn the monitor off and remove the cover.

Using the sensor puller, remove the sensor to be replaced by carefully pulling straight out.

Plug a new sensor into the empty socket. Make sure the sensor pins are aligned with the socket holes before firmly pushing the sensor all the way down.

Replace the monitor cover.

Turn on the power of the monitor and the newly installed sensors should be recognized. Let the monitor run for 15 minutes before calibration.

Some sensors, like NO and NH₃, require up to 24 hours on-bias in the monitor prior to calibration and use. *Refer to Technical Note 114 Sensor Specifications and Cross Sensitivities.*

NOTE: Calibrate all sensors prior to use!

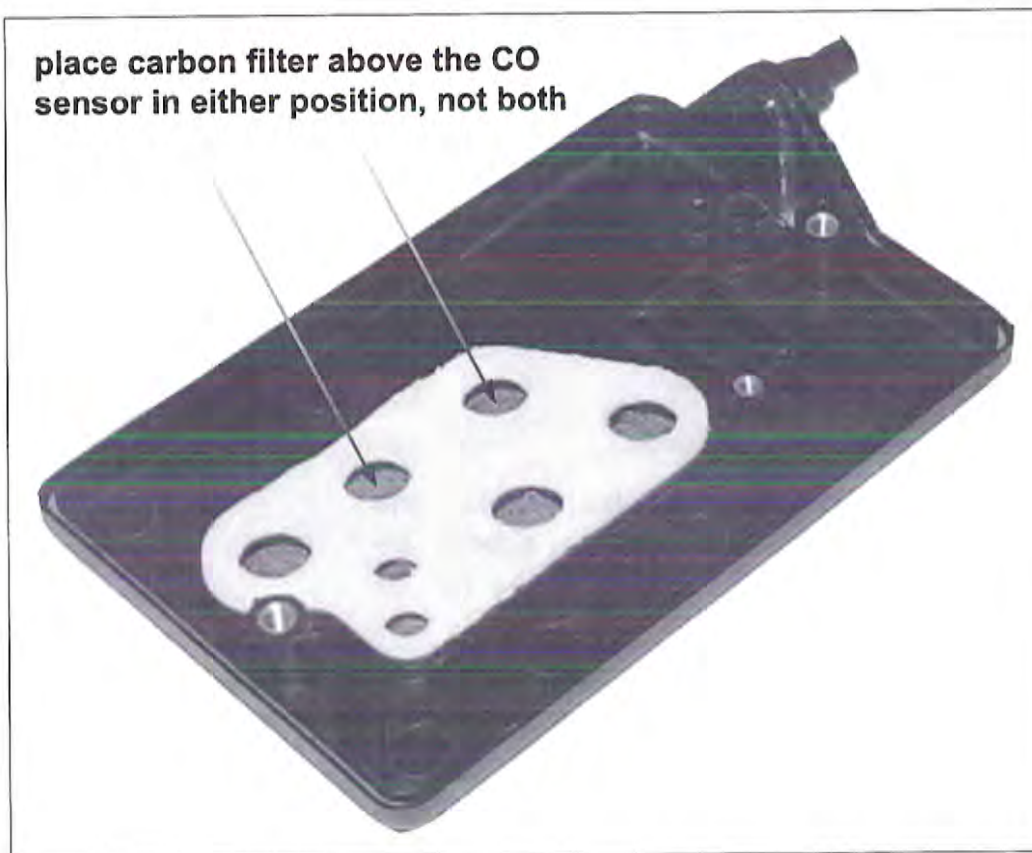


CO Sensor Charcoal Filters

CO sensors can be sensitive to hydrocarbons. To reduce or eliminate this cross sensitivity, a charcoal filter is installed in the gas plate above the CO sensor. The charcoal filter removes organic vapor cross-sensitivity and will last 4-6 weeks under normal operation conditions before it needs to be replaced. However, if the monitor is exposed to high concentrations of VOC gases, the carbon filter needs to be replaced more frequently. (P/N 008-3006-005, 5-pack; keep unused filters sealed during storage.)

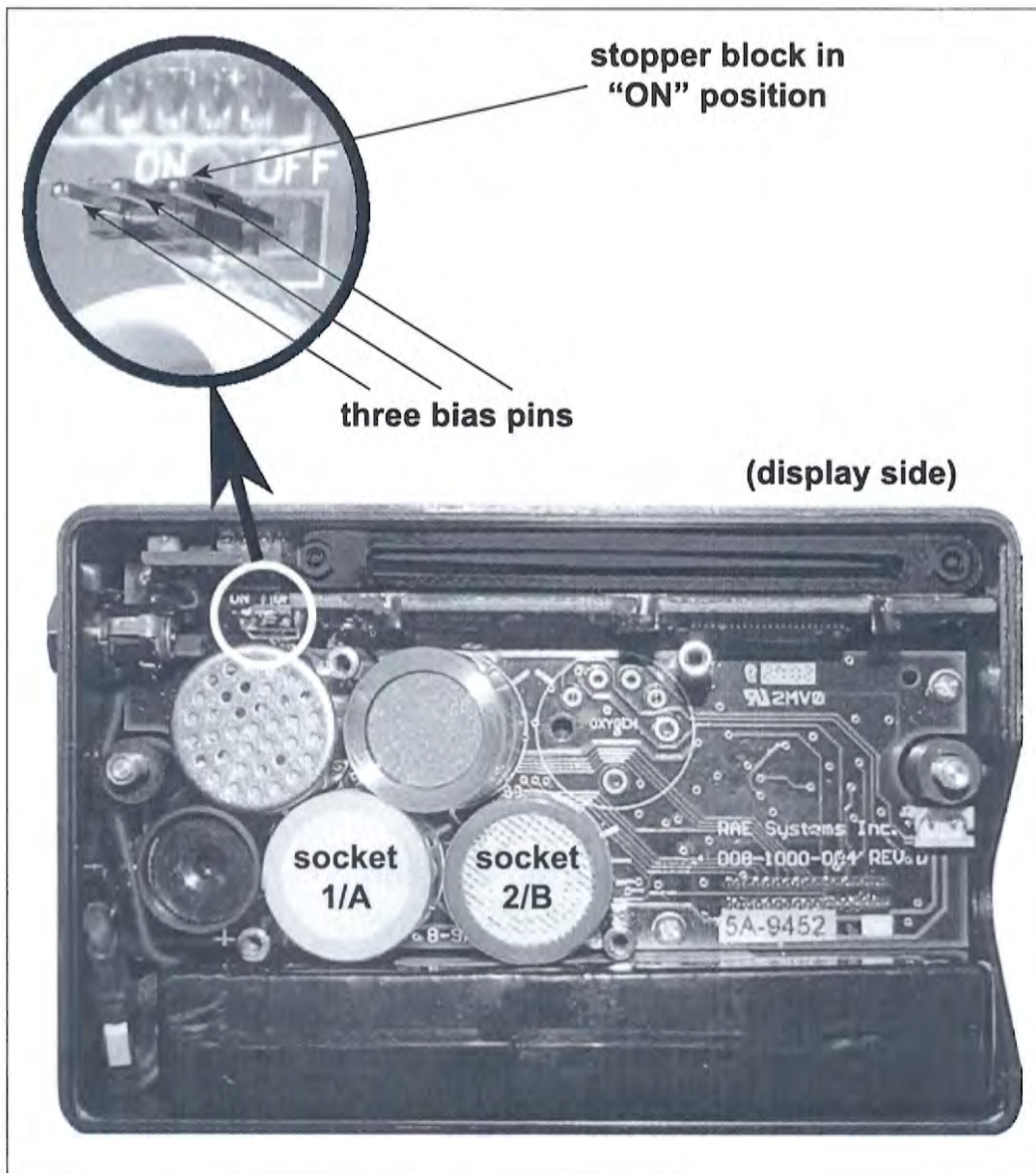
Refer to Technical Note-121 CO Sensor Cross-Sensitivity and Removal with Charcoal Filter for cross-sensitivity data.

⚠ The carbon filter used for CO sensors may lower the reading if used on other sensors. Remove the filter if another sensor is replacing a CO sensor in the monitor.



Special Bias Voltage for Toxic Gas Sensors

NO and some NH_3 sensors require a special high bias. The bias pins are located next to the PID sensor socket. Using the sensor puller, move the stopper block from the "OFF" pins to the "ON" pins. The sensor ID and bias voltage will be checked during the power on sequence. An error message appears if the sensors are plugged into the wrong socket, or if the bias voltage is disabled. Biased sensors require 24 hours on bias before calibration.



PID Sensor Cleaning/Replacement

During the course of normal operation, a film of gas vapor may build up inside the PID sensor module and the lamp; the rate of build-up depends on the type and concentration being sampled. As a guide, it is recommended to clean the PID sensor module and lamp only when the PID is malfunctioning.

Periodically cleaning the lamp window also removes film deposits and restores lamp sensitivity. Exercise with care when cleaning the window surface to avoid damage.

Turn the monitor off and remove the cover.

Remove the stainless steel shielding cap for the PID sensor. Using the sensor puller, remove the PID sensor by carefully pulling straight out.

Dip the entire PID sensor into RAE Systems' lamp cleaning solution (supplied in the Lamp Cleaning Kit, P/N 081-0002-000).

⚠ DO NOT store the methanol from the lamp cleaning kit in the same case as the MultiRae Plus, as long-term exposure to methanol can damage electrochemical sensors.

It is highly recommended to use an ultrasound bath for at least three minutes. Then thoroughly air-dry the sensor.

⚠ DO NOT use heat to dry sensors.

DO NOT disassemble PID sensor.

If the lamp is operational, use a cotton swab or lens tissue to clean the flat window surface with GC grade methanol. If the lamp does not turn on replace with a new lamp. Avoid contact with the flat window surface.

Reinstall the PID sensor. Install the shielding cap. Replace the monitor cover.



Taking Care of the Lamp

⚠ Never touch the window surface with fingers or anything which may leave a film. Water will degrade window surfaces, especially the 11.7 eV lamp window.

The 10.6 eV PID lamp has a 1-year warranty. The “Lamp” error is an indication of a problem with the lamp current. A dirty or contaminated sensor often causes high readings of the VOC sensor. A weak or inoperative lamp often causes low readings or no response to test gas. If the UV lamp is on while the error message persists, then it is necessary to adjust the lamp threshold. *Refer to Adjust Lamp Failure Threshold on page 27.*

Sampling Pump Replacement

The sampling pump is a positive displacement piston pump, which needs to be replaced as it approaches the end of its life span. The pump’s draw capability reduces significantly as it consumes a greater amount of energy to keep running. The sampling pump has a 1-year warranty. **To replace** the pump:

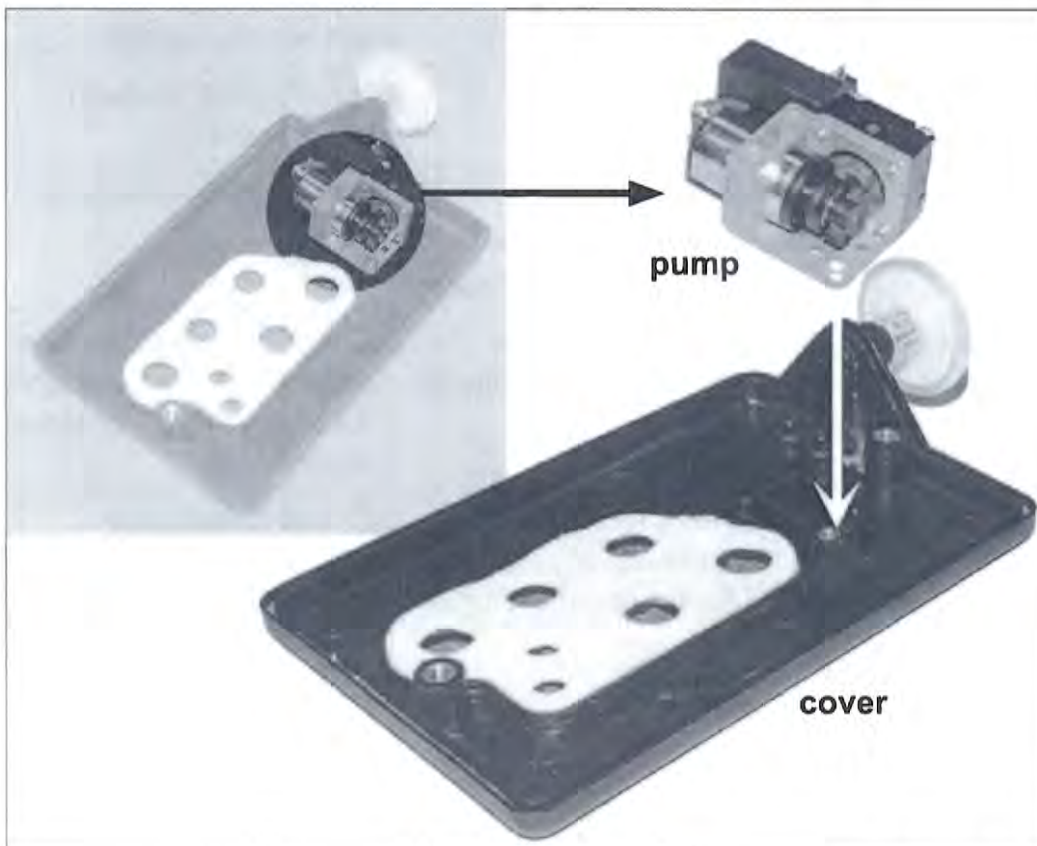
Turn the monitor OFF and remove the cover.

The sampling pump is attached to the cover.

Remove the single screw holding the pump to the cover.


Gently pull the pump assembly off the cover.

Replace with a new pump assembly and reassemble.



Troubleshooting

Technical Service: 1.888.723.4800 or email: Tech@raesystems.com

Problem	Possible Reason(s)	Possible Solution(s)
Cannot turn on after charging battery.	Defective battery. Microprocessor hang-up.	Charge or replace battery. Disconnect then reconnect battery to reset computer. Otherwise, install alkaline battery pack. If that still does not work, then call Service.
"Incorrect Year - Check Clock!" error message.	Battery has died and there is a mismatch between the date code on the sensors and its internal clock.	Press  and reset clock.
Cannot turn off. Corrupted characters.	Microprocessor hang-up.	Disconnect and reconnect battery to reset computer. Reload firmware.
No LED or LCD backlight.	Defective LED or LCD backlight.	Check if backlight is in manual mode. Otherwise, call service center.
Lost password.	Forgot.	Use ProRAE Suite to reset password.
Buzzer inoperative.	Bad buzzer. Setting could be in special run silent mode.	Call authorized service center.
Calibration error message.	No calibration gas input. Low sensitivity to calibration gas.	Check standard gas flow path or cylinder pressure. Change calibration gas or sensor.
"Voltage too high" error message, while charging.	Battery fuse blown. Wrong AC adapter. AC adapter not fully plugged in.	Check battery and adapter.
"Bat" error message.	Battery low.	Recharge battery.

High pump noise. No inlet suction.	Leaky inlet path. Defective pump.	Check inlet connection. Clean or replace pump.
Abnormally low reading.	Bad calibration. Low sensitivity to calibration gas. Wrong span value. Bad sensor. Low flow.	Recalibrate. Use stronger span gas. Check span value. Replace sensor. Replace filters. Check flow.
Abnormally high reading.	Bad calibration. Wrong span value. Dirty PID sensor. Dirty filters. Excessive moisture.	Recalibrate. Check span value. Clean PID sensor in methanol in ultrasound bath. Replace filters. Dry PID sensor.
Reading jumping around.	Incorrect calibration gas. Wrong span value.	Calibrate the sensors. Use different calibration gas. Change sensor.
Read a small background value.	Small background gas level present. Sensor zero drift or newly installed.	Run fresh air calibration. Wait for newly installed sensor to stabilize.
"Lamp" error message.	Wrong threshold. Weak lamp. Dirty Sensor.	Adjust threshold. Clean or replace lamp. Clean PID sensor.
VOC reading plateaus at certain level.	Weak PID lamp. Dirty PID sensor.	Replace lamp. Clean lamp & PID sensor. Replace filters.
Full scale measurement in humid environment.	Dirty or wet sensor.	Clean and dry sensor. Replace external filter.

Specifications

Size	4.65"L x 3.0"W x 1.9"H (11.8 x 7.6 x 4.8 cm)
Weight	16 oz with battery (454g)
Sensors	Up to 5 sensors including: <ul style="list-style-type: none"> • Photo-Ionization detector for VOCs, 10.6 eV lamp standard • Protected catalytic bead for combustible gases • Interchangeable electrochemical sensors for oxygen and toxic gases (2)
Battery	<ul style="list-style-type: none"> • Interchangeable Li-Ion and alkaline battery packs • Rechargeable units include lithium-ion battery pack with internal smart charging, 120V AC/DC wall adapter, and spare alkaline battery pack
Operating Hours	<ul style="list-style-type: none"> • 14 hours continuous with Li-Ion (typical) • Unit will run and charge simultaneously
Display	2 line, 16 digit LCD with LED backlighting automatically in dim light or alarm condition
Keypads	1 operation and 2 programming keys
Direct Readout	Instantaneous (up to 5) values: <ul style="list-style-type: none"> • Oxygen as percentage by volume • Combustible gas as percentage of lower explosive level (LEL) • Toxic gases and VOCs as parts per million by volume (VOC scaleable using correction factors) • High and low values for all gases • STEL and TWA values of toxic gases and VOCs • Battery and shut down voltage • Date, time, elapsed time, temperature
Alarms	90 dB buzzer and flashing red LED to indicate exceeded preset limits: <ul style="list-style-type: none"> • High: 3 beeps and flashes per second • Low: 2 beeps and flashes per second • STEL and TWA: 1 beep and flash per second • Automatic reset or latching with manual override • Additional diagnostic alarms and display messages for low battery and pump stall
Datalogging	20,000 points (80 hours, 5 channels at one minute intervals) download to PC with serial number of unit, user ID, site number, and calibration date

Calibration	Two-point field calibration for zero and span gas
Sampling Pump	Internal two-speed pump. Flow rates: <ul style="list-style-type: none"> • Low: ~200 cc/min • High: ~300 cc/min
Low Flow Alarm	Auto shut-off pump at low flow condition
Temperature	-4° to 113°F (-20° to 45°C)
Humidity	0% to 95% relative humidity (non-condensing)
Attachment	Wrist strap and high-visibility rubber boot
Warranty	Lifetime on non-consuming components (per RAE Standard Warranty). 2 years for O ₂ , LEL, CO, and H ₂ S sensors. 1 year all other sensors. 1 year pump, 1 year battery, 1 year for 10.6eV PID lamp.
EMI Immunity	No effect when exposed to 0.43 mW/cm RF interference (5 watts at 12 inches)
Intrinsic Safety	U.S.A. and Canada: UL & cUL Class I, Division I, Groups A, B, C, D, hazardous locations, Temperature Code T3C Europe: DEMKO 03 ATEX 0308256X; EEx ia d IIC T4 (w/ Battery P/N 500-0029); EEx ia d IIC T3 (w/ Battery P/N 500-0037)

Range, Resolution & Response Time

(t₉₀ for pump-equipped instruments)

Sensor	Range	Resolution	t ₉₀ (sec)	Presoak Time for 60-sec Cal
LEL	0-100% LEL	1%	15	None
VOC	0-200 ppm	0.1 ppm	10	None
VOC	200-2000 ppm	1 ppm	10	None
O ₂	0-30%	0.1%	15	None
CO	0-500 ppm	1.0 ppm	40	None
H ₂ S	0-100 ppm	1.0 ppm	35	None
SO ₂	0-20 ppm	0.1 ppm	35	None
NO	0-250 ppm	1.0 ppm	30	None
NO ₂	0-20 ppm	0.1 ppm	25	None
Cl ₂	0-50 ppm	0.1 ppm	60	60 sec
PH ₃	0-5 ppm	0.1 ppm	60	60 sec
NH ₃	0-50 ppm	1.0 ppm	150	90 sec
HCN	0-100 ppm	1.0 ppm	200	170 sec

[illegible]

Notes



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www.raesystems.com

MiniRAE 2000

Portable VOC Monitor PGM-7600



OPERATION AND MAINTENANCE MANUAL

(Document No.: 011-4001-000)
Revision E, May 2005



ATTENTION!

For European Applications

- A. CE 0575 II 1G/2G
DEMKO 03 ATEX 0204759X
Eex ia IIC T4**
- B. Recharge batteries only in non-hazardous locations.**
- C. Do not connect external cable to serial interface jack in hazardous locations.**
- D. Use RAE Systems Adapter P/N 500-0072 for connection to communication port and charging jack only in a non-hazardous area.**

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WARNING



- Do NOT proceed before reading -

This manual must be carefully read by all individuals who have or will have the responsibility for using, maintaining, or servicing this product.

The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions.

CAUTION!!

To reduce the risk of electric shock, turn off power before removing the monitor cover. Disconnect the battery before removing sensor module for service. Never operate the monitor while the cover is removed. Remove monitor cover and sensor module only in an area known to be non-hazardous.

The model PGM-7600 equipment is classified as to intrinsic safety for use in class I, division 1, groups A, B, C, D, or non-hazardous locations only.

Special Notes

-1-

When the MiniRAE 2000 Monitor is taken out from the transport case and turned on for the first time, there may be some residual organic or inorganic vapor trapped inside the detector chamber. The initial PID sensor reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the monitor. After running for several minutes, the residual vapor in the detector chamber will be cleared and the reading should return to zero.

-2-

The battery of the MiniRAE 2000 monitor will discharge slowly even if it is turned off. If the monitor has not been charged for 5-7 days, the battery voltage will be low. Therefore, it is a good practice to always charge the monitor before using it. It is also recommended to fully charge the monitor FOR AT LEAST 10 HOURS before first use. See Section 7 for more information on battery charging and replacement.

WARNINGS

STATIC HAZARD: Clean only with damp cloth.

For safety reasons this equipment must be operated and serviced by qualified personnel only. Read and understand instruction manual completely before operating or servicing.

Use only RAE Systems battery packs, part nos. 012-3050, 012-3051 or 012-3052. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service.

For maximum safety, the accuracy of the MiniRAE 2000 should be checked by exposing it to a known concentration calibration gas before each day's use.

AVERTISSEMENTS

DANGER RISQUE D'ORIGINE ELECTROSTATIQUE:
Nettoyer uniquement avec un chiffon humide.

Pour des raisons de sécurité, cet équipement doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d'instructions en entier avant d'utiliser, d'entretenir ou de réparer l'équipement.

Utiliser seulement l'ensemble de batterie RAE Systems, la référence 012-3050, 012-3051 au 012-3052. Cet instrument n'a pas été essayé dans une atmosphère de gaz/air explosive ayant une concentration d'oxygène plus élevée que 21%. La substitution de composants peut compromettre la sécurité intrinsèque. Ne charger les batteries que dans emplacements désignés non-dangereuse.

La calibration de toute instruments de RAE Systems doivent être testé en exposant l'instrument a une concentration de gaz connue par une procédure diétalonnage avant de mettre en service l'instrument pour la première fois.

Pour une securite maximale, la sensibilité du MiniRAE 2000 doit être verifier en exposant l'instrument a une concentration de gaz connue par une procédure diétalonnage avant chaque utilisation journalière.

1. GENERAL INFORMATION

MiniRAE 2000 Portable VOC Monitor (Model PGM 7600) is a compact monitor designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It monitors Volatile Organic Compounds (VOC) using a Photo-Ionization Detector (PID) with a 9.8 eV, 10.6 eV, or 11.7 eV gas discharge lamp. Features are:

- **Lightweight and Compact**
 - Compact, light weight (19 oz.) and rugged design
 - Built-in sample draw pump
- **Dependable and Accurate**
 - Up to 10 hours of continuous monitoring with rechargeable battery pack
 - Designed to continuously monitor VOC vapor at ppm levels
- **User Friendly**
 - Preset alarm thresholds for STEL, TWA, low and high level peak values. Audio buzzer and flashing LED display are activated when the limits are exceeded.
- **Datalogging Capabilities**
 - 15,000 point datalogging storage capacity for data download to PC



MiniRAE 2000 consists of a PID with associated microcomputer and electronic circuit. The unit is housed in a rugged ABS + PC case with a backlit 1 line by 8 character dot matrix LCD and 3 keys to provide easy user interface.

1.1 General Specifications

Table 1.1

Portable VOC Monitor Specification	
Size:	8.2"L x 3.0"W x 2.0"H
Weight:	19.5 oz with battery pack
Detector:	Photo-ionization sensor with 9.8, 10.6, or 11.7 eV UV lamp
Battery:	A 4.8V /1250 mAH Rechargeable Nickel Metal Hydride battery pack (snap in, field replaceable)
Battery Charging:	10 hours charge through built-in charger
Operating Hours:	Up to 10 hours continuous operation
Display:	1 line by 8 characters 5x7 dot matrix LCD (0.4" character height) with LED back light automatically in dim light
Range, Resolution & Response time (t ₉₀):	
Isobutylene (calibration gas)	
	0-99 ppm 0.1 ppm 2 sec
	100-1,999 ppm 1.0 ppm 2 sec
	2000-10,000 ppm 1.0 ppm 2 sec
Measurement Accuracy (Isobutylene):	
	0 – 2000 ppm: ± 2 ppm or 10% of reading.
	> 2000 ppm: ± 20% of reading
PID Detector:	Easy access to lamp and sensor for cleaning and replacement
Correction Factors:	Built-in 102 VOC gases
Calibration:	Two-point field calibration of zero and standard reference gas
Calibration Memory:	
	Store up to 8 separate calibration, alarm limits and span value
Inlet Probe:	Flexible 5" tubing
Keypad:	1 operation key and 2 programming keys

GENERAL INFORMATION

Direct Readout:	Instantaneous, average, STEL and peak value, battery voltage and elapsed time
Intrinsic Safety:	UL & cUL Class 1, Division I, Group A,B,C,D, Temperature Code T3C (US & Canada);  0575  II 1G DEMKO 02 ATEX 0204759 Eex ia IIC T4 (Europe)
EM Interference:	No effect when exposed to 0.43 W/cm ² RF interference (5 watt transmitter at 12 inches)
Alarm Setting:	Separate alarm limit settings for Low, High, STEL and TWA alarm
Operating Mode:	Survey or Hygiene mode
Alarm:	90 dB buzzer and flashing red LEDs to indicate exceeded preset limits, low battery voltage, or sensor failure.
External Alarm:	Optional plug-in pen-size vibration alarm or remote alarm
Alarm Mode:	Latching or automatic reset
Real-time Clock:	Automatic date and time stamps on data logged information
Datalogging:	15,000 points with time stamp, serial number, user ID, site ID, etc.
Communication:	Upload data to PC and download instrument setup from PC through RS-232 port
Sampling Pump:	Internally integrated. Flow rate: 450-550 cc/min.
Temperature:	0° to 45°C (32° to 113°F)
Humidity:	0 % to 95 % relative humidity (non-condensing)
Housing:	ABS + PC, conductive coating, splash and dust proof, will withstand 1 meter drop test with rubber boot
Attachment:	Wrist strap, rubber boot and belt clip

2. OPERATION OF MINIRAE 2000

The MiniRAE 2000 Portable VOC Monitor is a compact Monitor designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It gives real time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment the MiniRAE 2000 is preset with default alarm limits and the sensor is pre-calibrated with standard calibration gas. However, the user should test the instrument and verify the calibration before the first use. After the monitor is fully charged and calibrated, it is ready for immediate operation.

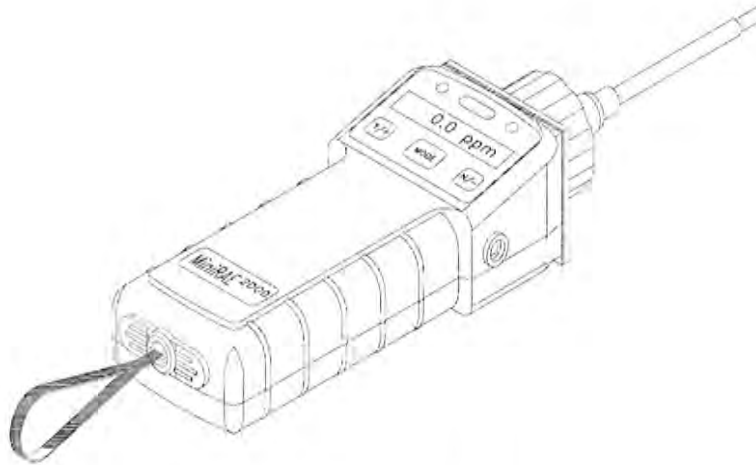


Figure 2-1 MiniRAE 2000

2.1 Physical Description

The main components of the MiniRAE 2000 Portable VOC monitor include:

- Three keys for user to interact with the monitor: 1 operation key and 2 programming keys for normal operation or programming of the monitor
- LCD display with back light for direct readout and calculated measurements
- Buzzer and red LED's for alarm signaling whenever the exposures exceed preset limits
- Wrist strap
- Charge contact for plugging directly to the charging station
- Gas entry and exit ports
- Serial communication port for PC interface
- External alarm and analog output port
- Protective rubber cover

2.2 Keys and Display

Figure 2.2 shows the LCD display and the keypad on the front panel of the monitor. The function of the 3 keys during normal operation are summarized below:

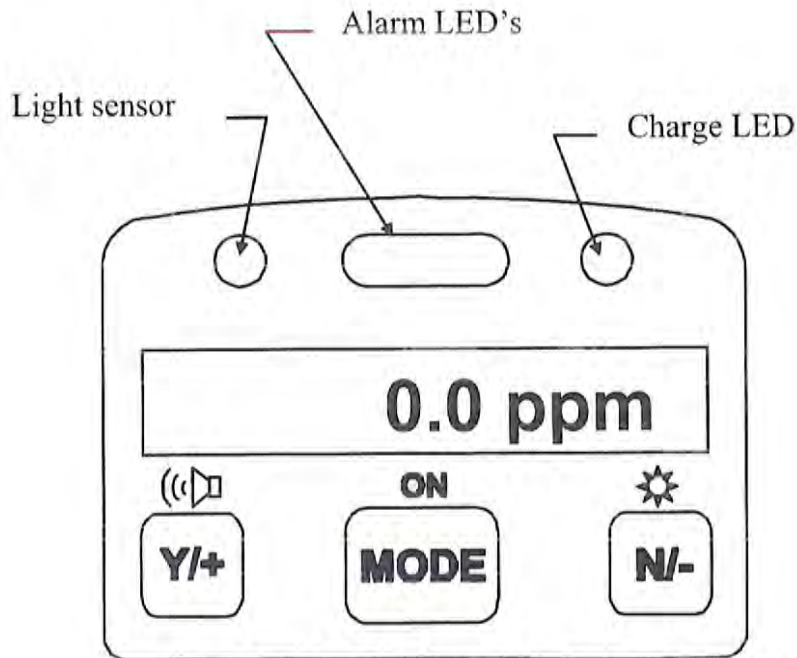


Figure 2-2 LCD Display and Keypad

Key Function in Normal Operation

- [MODE]** -Turn on/off the power* and step through menu items
- [N/-]** -Toggle on/off the back light, negative acknowledge, decrease value
- [Y/+]** -Start measurement, positive acknowledge, increase value

* Pressing and holding **[MODE]** key for 5 seconds turns off the power to the monitor. Monitor will beep once per second and display countdown timer during power-down sequence. Press **[MODE]** key momentarily to step through menu items. To save time, press any key during message scrolling to skip to the end of the message.

2.3 Power On/Off

To turn on the MiniRAE 2000 portable VOC monitor, press **[MODE]** key for one second and release. The audio buzzer will beep once and the air pump will turn on. The display will show “ON!..” and then “Ver n.nn” to indicate the unit’s current firmware version number. Next displayed are the serial number, the model number, Operating mode, current date and time, unit internal temperature, gas selected, high low, STEL, TWA/AVG alarm limits, battery voltage, and shut off voltage. Also displayed are internal mode settings such as User mode, Alarm mode, datalog time remaining and log periods in the respective order.

To turn off the MiniRAE 2000 portable VOC monitor, press and hold the **[MODE]** key for 5 seconds. The monitor will beep once per second during the power-down sequence with a count down timer showing the number of remaining seconds. The message “Off!..” flashes on the LCD display and the display will go blank indicating that the monitor is turned off.

Data protection during power off

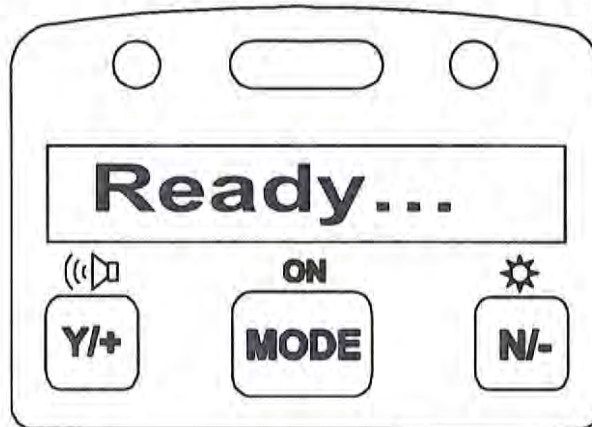
When the monitor is turned off, all the current real time data including last measured value are erased. However, the datalog data is preserved in non-volatile memory. Even if the battery is disconnected, the datalog data will not be lost. While the power is off, the real time clock will continue to operate until the battery is completely drained (usually in 4-5 days without any charging). If the battery is completely drained or is disconnected from the monitor for more than 30 minutes, the real time clock will be lost. In this case, the user needs to enter the real time clock information again, as described in Section 4, or send the PC clock during configuration through the PC communication.

2.4 Operation

The **MiniRAE 2000** VOC monitor has two operation modes: **Survey** and **Hygiene** mode. The **Survey mode** allows the user to manually start and stop the monitoring/measuring operation and display certain exposure values. In the **Hygiene mode**, the monitor runs continuously after the monitor is turned on. Refer to Section 4.7.1 for switching between the two modes.

2.4.1 Survey Mode

After the monitor is turned on, it runs through the start up menu. Then the message “**Ready...**” is displayed (see figure below).



At this point, the user has two options:

1. Step through the Main Menu.
2. Take a measurement.

Press the [MODE] button to step through the Main Menu. Press the [Y/+] button to proceed to take a measurement.

The Main Menu

Press the [MODE] button to enter the Main Menu. Press the [Y/+], [MODE] or [N/-] as indicated in the flow chart below to step through the Main Menu. The PID sensor and pump are turned off during this time.

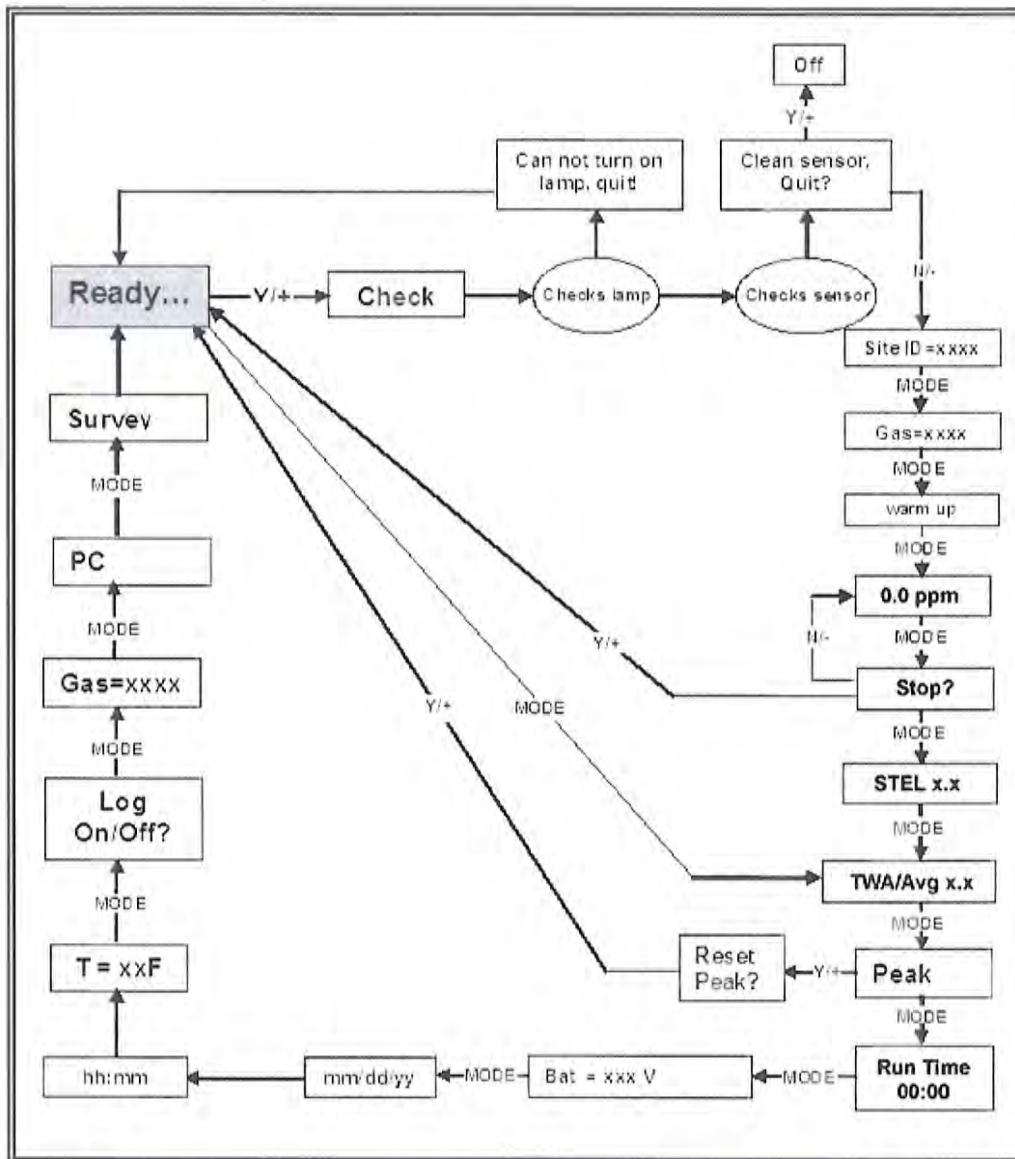
The Main Menu functions are:

- **Ready...**
- **Check**
- **Site ID = xxxx**
- **Gas = xxxx**
- **Warm up**
- **X.x ppm**
- **Stop?**
- **TWA/Avg x.x ppm**
- **STEL x.x ppm**
- **Peak x.x ppm**
- **Run time hh:mm**
- **Bat = X.XV**
- **Mm/dd/yy**
- **hh:mm**
- **T = xxxF [date, time and temperature (°C or °F)]**
- **Log On/Off?**
- **PC Comm?**
- **Survey**

OPERATION

These functions are arranged in a “round robin” order. To select a specific function, press the button as shown below until the desired function appears.

Main Menu



The Main Menu Functions

- **Ready...:** Indicates that the monitor is ready to take a measurement or to step through the Main Menu. Press the [Y/+] button to advance to taking a measurement (read “Taking a Measurement” on Page 2-12 for details).

Note: The **Ready...** screen is skipped if the menu is cycled through while a measurement is running.

- **Check...:** This message displays while the system is checking the lamp and the sensor. If the lamp test succeeds, the system will progress to checking the sensor. If the lamp test does not succeed, the display will read **Can not turn on lamp, quit!**
 - **Can not turn on lamp, quit!:** This message displays when the lamp does not turn on. The system will automatically return to **Ready...** allowing the user to test the lamp again. If the lamp fails a second time, turn the monitor off and refer to Section 7.2 “**PID Sensor & Lamp Cleaning / Replacement**”.
 - **Clean Sensor, Quit?:** This message displays when the sensor requires cleaning. Press the [Y/+] button to turn the monitor off and clean the sensor. Press the [N/-] button and the system will progress to the **Site ID = xx**

- **Site ID = xxxx:** This display shows the Site ID and indicates that the monitor is about to start taking measurements (read “Taking a Measurement” for details)

Note: This display appears only after a measurement has been started. It does not appear when the user is cycling through the Main Menu and the monitor is idling.

- **Gas = xxxx:** This display identifies the gas to be measured and indicates that the monitor is about to take a measurement (read “Taking a Measurement” for details)

OPERATION

Note: This display appears only after a measurement has been started. It does not appear when the user is cycling through the Main Menu and the monitor is idling.

- **x.x ppm:** (read “Taking a Measurement” for details)

Note: This display appears only after a measurement has been started. It does not appear when the user is cycling through the Main Menu and the monitor is idling.

- **TWA/Avg:** Displays (in ppm) the Time Weighted Average (TWA) or the Average since the start of the measurement. The average is recalculated every minute.
- **STEL:** Displays the Short Term Exposure Limit.
- **PEAK:** Displays (in ppm) the highest instantaneous reading since the start of the measurement. If [Y/+] is pressed while the peak reading is displayed, the unit will ask **Reset Peak?**. If [Y/+] is pressed again, the peak value will be cleared and the display will return to the **Ready...** message or instantaneous reading. The peak reading is automatically reset when a new measurement is started by pressing [Y/+] from the **Ready...** screen.
- **Run time hh:mm:** The duration of the current measurement period.
- **Bat = X.XV:** The current battery voltage.

Note: A fully charged battery pack should show 4.8 volts or higher. When the battery voltage falls below 4.4 volts, a flashing “**Bat**” will appear as a warning message. At that point, you have 20-30 minutes of run time remaining. When the battery voltage falls below 4.2 volts the monitor turns off automatically.

- **Mm/dd/yy:** The current date.
- **hh:mm:** The current time (24-hour format)

- **T = xxxF:** The internal unit temperature in degrees Fahrenheit. (see Section 4.7.13 to change temperature units)
- **Log on/Off?:** Allows the user to start datalogging of the current measurement. A superscript “L” flashes in the ppm measurement display when datalogging is on. This screen is not shown when datalogging is disabled or when the monitor is not operating in manual start/stop mode.
- **PC Comm?:** This function enables the user to upload data from the MiniRAE 2000 to a Personal Computer (PC) or send/receive configuration information between a PC and the MiniRAE 2000. Press [MODE] to return to **Ready...**

To communicate with a PC, connect the monitor to the serial port of a PC and start the MiniRAE 2000 application software. Press the [Y/+] button and the LCD displays “**pause monitor, ok?**” Press the [Y/+] button one more time, and the display shows “**Comm...**” The monitor is now ready to receive commands from the PC.

- **Survey:** This function displays the Current Operating Mode (Survey or Hygiene).

Taking a Measurement

There are two ways to start a measurement.

1. Operating in Hygiene mode.
2. Manually start and stop measurement in Survey mode.

To start a measurement in Hygiene mode, please refer to Section 4.7.1, “**Change Operation Mode**”. To start a measurement in Survey Mode, the MiniRAE 2000 monitor must first be in the “Ready...” mode. This is the mode to which the monitor normally powers up.

Measurement phases

1. Ready
2. Start measurement
3. Measurement display and datalogging
4. Stop measurement

Ready

The display reads **Ready...** indicating the unit is ready to start a measurement.

Start Measurement

Press the [Y/+] button to start the check cycle (see above), and then the measurement cycle.

After completing the **Check** cycle, the display will show the **Site ID** and then the **Gas** selected for measurement. The pump will start and the reading will be displayed. The **Peak** and **Average** values will be automatically reset to zero.

Measurement Display and Datalog

Instantaneous readings of the gas concentration in parts per million (ppm) are updated every second. A flashing superscript **L** is displayed when datalogging is on. Datalog information is saved only after one full datalog period is completed.

Stop Measurement

Press the [MODE] button and the display shows Stop? Press [N/-] to continue measurement and [Y/+] to stop the measurement and datalog event. The pump stops automatically when measurement is stopped. Peak and average values for the current measurement can be read in idle mode until a new measurement is started.

Automatic Increment of Site ID

Every time a measurement is taken, the site ID will be incremented by one automatically in Survey mode.

Variable Alarm Signal

In Survey Mode, if the measurement exceeds the low alarm limit, the buzzer and flashing alarm are activated and will beep/flash once per second. The alarms will increase in frequency as the gas concentration approaches the high alarm limit reaching 8 times per second when the high alarm has been exceeded.

Press [Y/+] key to clear if latching alarm.

2.4.2 Hygiene Mode

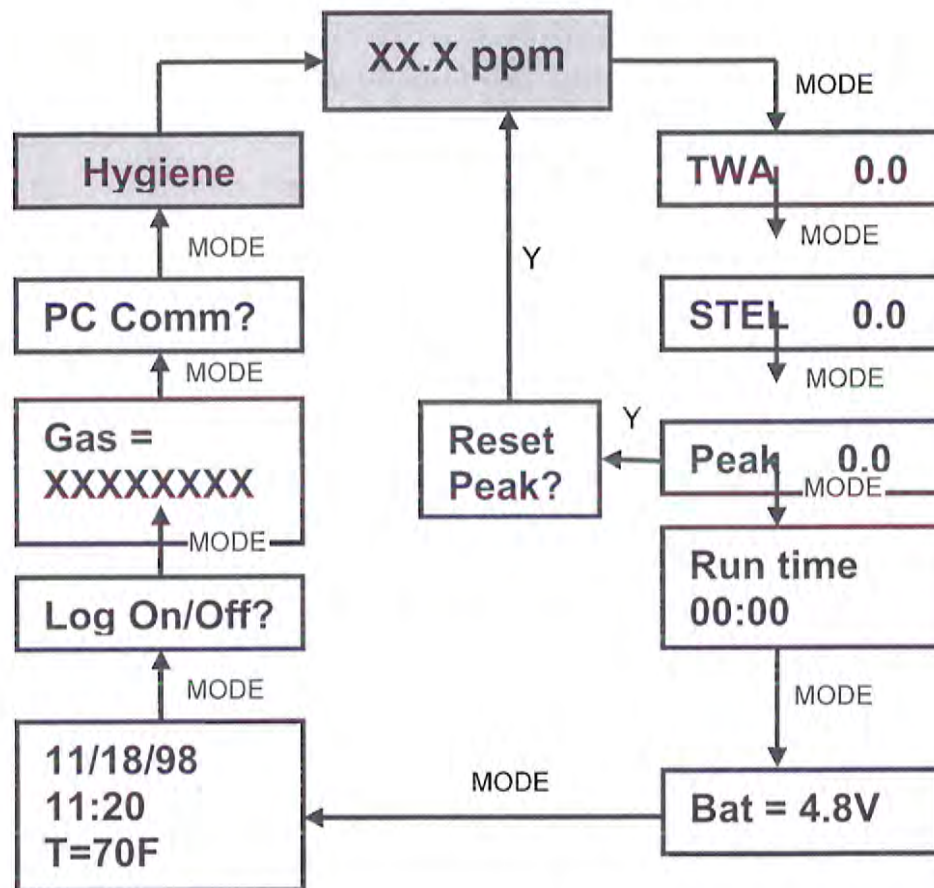
In Hygiene Mode, the unit will continuously taking measurements, once the power is turned on. After the initial start-up sequence displaying the current monitor settings, the LCD displays the instantaneous readings.

The Hygiene operation menu displays include:

- **Real time readings in ppm**
- **Current TWA/Avg, STEL and Peak values (see Section 4.6.6)**
- **Run time**
- **Current battery voltage**
- **Date, time and temperature**
- **Log on/off?**
- **Gas name**
- **PC communication?**
- **Hygiene**

Detailed description of most of these displays are the same as Section 2.4.1.

HYGIENE MODE MAIN MENU



To choose a specific display, press the [MODE] key one or more times until the desired display appears, or the [Y/+] key where indicated with a Y.

Note: To get back to instantaneous reading from any of the above display, press [MODE] key repeatedly until the “XX.X ppm” display appears.

2.5 Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings: Low, High, TWA and STEL). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn the user of the alarm condition.

In addition, the MiniRAE 2000 will alarm if one of the following conditions occurs: battery voltage falls below a preset voltage level (4.4 V), failure of UV lamp, pump stall, or when the datalog memory is full. When the low battery alarm occurs, there will be approximately 20-30 minutes of operating time remaining. When the battery voltage falls below 4.2 V, the monitor will turn off automatically.

Alarm Signal Summary:

Condition	Alarm Signal
Gas exceeds "High Alarm" limit	3 beeps/flushes per second
Gas exceeds "Low Alarm" limit	2 beeps/flushes per second
Gas exceeds "TWA" limit	1 Beeps/flushes per seconds
Gas exceeds "STEL" limit	1 Beeps/flushes per seconds
Pump failure	3 beeps/flushes per second plus "Pump" message on LCD
PID lamp failure	3 beeps/flushes per second plus "Lamp" message on LCD
Low battery	1 flash per second, 1 beep per minute plus "Bat" message on LCD
Memory full	1 flash per second plus "Mem" message on LCD

Alarm Signal Testing:

Under normal non-alarm conditions, it is possible to test the MiniRAE 2000 LED and buzzer in Special Diagnostic Mode (see Section 8 for details).

2.6 Preset Alarm Limits and Calibration

The MiniRAE 2000 portable VOC monitor is factory calibrated with standard calibration gas, and is programmed with default alarm limits. There are 102 gas settings stored in the library. Some examples of calibration and alarm limits are shown below. Refer to Section 4 on programming procedures for selecting a different gas, perform a calibration or set new alarm limits.

Factory Calibration and Preset Alarm Limits

Cal Gas	Cal Span	unit	Low	High	TWA	STEL
Isobutylene	100	ppm	50	100	100	250
Hexane, n-	100	ppm	500	750	500	750
Xylene, m-	100	ppm	100	150	100	150
Benzene	5	ppm	2	5	5	2
Styrene	50	ppm	20	40	20	40
Toluene	100	ppm	50	100	50	100
Vinyl Chloride	10	ppm	5	10	5	10
Custom	100	ppm	50	100	50	100

2.7 Integrated Sampling Pump

The MiniRAE 2000 portable VOC monitor includes an integrated sampling pump. This is a diaphragm type pump that provides a 500-600 cc per minute flow rate. Connecting a Teflon or metal tubing with 1/8 inch inside diameter to the gas inlet port of the MiniRAE 2000, this pump can pull in air samples from 200 feet away horizontally, or 90 feet vertically, at about 3 feet per second flow speed.

The pump turns on when a measurement is started, and turns off when the sample is manually stopped in Survey mode or when the unit is turned off from Hygiene Mode.

If liquid or other objects are pulled into the inlet port filter, the monitor will detect the obstruction and shut down the pump immediately. The alarm will be activated and a flashing error message "Pump" will be also displayed on the LCD display.

The user should acknowledge the pump shut off condition by clearing the obstruction and pressing the [Y/+] key to re-start the pump.

The pump stall threshold is set in the special Diagnostic Mode (Section 8).

2.8 Back Light

The LCD display is equipped with an LED back light to assist in reading the display under poor lighting conditions. Pressing and holding the [N/-] key for one second in normal operation can turn on the backlight. The backlight can be turned off by pressing [N/-] a second time. If the [N/-] key is not pressed, the back light will be turned off automatically after a pre-programmed time-out period to save power.

In addition, the ambient light is sensed and the back light will be turned on automatically if the ambient light is below a threshold level. The back light is turned off automatically when the ambient light exceeds the threshold level.

See Section 8 for instructions on how to set the light threshold level.

Note: The LED backlight consumes about 20-30% of the total average current, when the instrument is idle or not taking a measurement.

2.9 Datalogging

During datalogging, the MiniRAE 2000 Portable VOC monitor flashes a superscript “L”, on the display to indicate that datalogging is enabled. The monitor stores the time stamp, sample number, and measured gas concentration at the end of every sample period (when data logging is enabled). In addition, the following information are stored: user ID, site ID, serial number, last calibration date, and alarm limits. All data are retained (even after the unit is turned off) in non-volatile memory so that it can be down loaded at a later time to a PC.

Datalogging event

When Datalogging is enabled, measurement readings are being saved. These data are stored in “groups” or “events. A new event is created and stored each time the monitor is turned on, or a configuration parameter is changed, or datalogging is interrupted (e.g. Communication with PC during Hygiene mode). Information, such as start time, user ID, site ID, gas name, serial number, last calibration date, and alarm limits will be recorded.

Datalogging sample

After an event is recorded, the unit records a shorter form of the data. This data contains: the sample number, time (hour/minute) and gas concentration.

3. OPERATION OF ACCESSORIES

The accessories for the MiniRAE 2000 include:

- An AC Adapter (Battery Charger)
- Alkaline battery holder
- Water Trap Filter

Optional Accessories:

- Dilution Fitting
- Calibration adapter
- Calibration regulator and Flow controller
- Organic Vapor Zeroing kit

3.1 Standard Kit and Accessories

1) AC Adapter (Battery Charger)

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in area known to be non-hazardous.

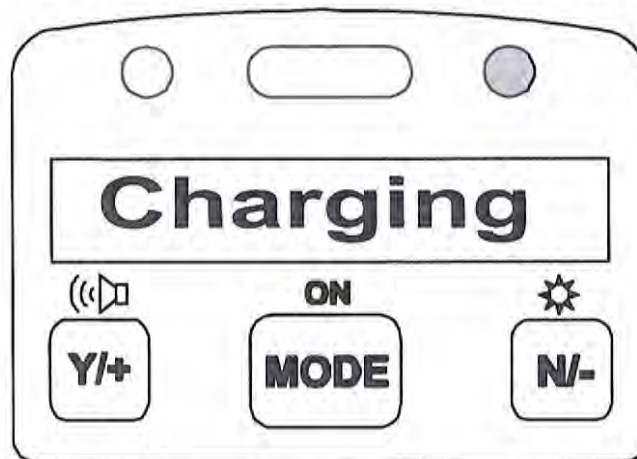
Ne charger les batteries que dans emplacements designés non-dangereuses.

A **battery charging circuit** is built into the MiniRAE 2000 monitor. It only needs a regular AC to 12 V DC adapter (wall mount transformer) to charge the monitor.

To charge the battery inside the MiniRAE 2000 monitor:

1. Power off the Monitor.
2. Connect the AC adapter (or the optional automotive charging adapter) to the DC jack on the MiniRAE 2000 monitor. If the unit was off, it will automatically turn on.
3. The first message displayed will be "Deep discharge?" The unit will ask this question for three times. If the user wants to discharge the battery pack, affirm this query with the [Y/+] key, otherwise the unit will move on to the charge mode directly.

4. While charging, the display message will alternate between “Charging” and “Bat=x.xV” (x.x is the present battery voltage). The LED should be red in color when charging.



5. When the battery is fully charged, the LED will change from red to green and the message “Fully charged” will appear on the display. After the battery is fully charged, the unit will enter the “trickle charge” mode. In which, the red LED will turn on for several seconds every minute, to maintain the full charge.

A completely discharged MiniRAE 2000 monitor will be charged to full capacity within 10 hours. The battery will be drained slowly even if the monitor is turned off. If the monitor has not been charged for 7-10 days, the battery voltage will be low.

The factory-supplied battery is designed to last for 10 hours of normal operation (no alarm, no back light condition), for a new battery under the best condition. As the battery becomes older or is subject to adverse conditions (such as cold ambient temperature), the battery capacity will be reduced significantly.

2) Alkaline Battery Holder

An alkaline battery holder is supplied with each MiniRAE 2000. It accepts four AA size alkaline batteries and can be used in place of the Ni-MH or Ni-Cd battery pack to provide approximately 12-14 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Ni-Cd or Ni-MH battery pack.

To install the adapter, remove the cover of the battery compartment. Remove the Ni-Cd or Ni-MH battery pack from the battery compartment and replace with the alkaline battery adapter. Replace the battery compartment cover.

The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the monitor.

Note: The AA Alkaline battery adapter supplied by RAE Systems Inc. is intrinsically safe!

3) Water Trap Filter

The water trap filter is made of PTFE (Teflon[®]) membrane with a 0.45 micron pore size to prevent water from being sucked into the sensor manifold, which would cause extensive damage to the monitor. It will also remove any dust and other particles from entering the monitor and prolong the operating life of the sensor. To install the water trap, simply insert it to the front of the inlet tube of the MiniRAE 2000 monitor.

3.2 Optional Accessories

1) Dilution Fitting

The user may wish to install a dilution fitting on the inlet to dilute the gas samples. One application for a dilution fitting is to measure organic gas when the concentration exceeds the upper limit of the sensor range.

Make sure to set the dilution ratio in the programming mode (see Section 4.7.9) so that the correct gas reading will be displayed when the dilution fitting is used.

WARNING: To use a dilution fitting, the user must have the monitor located in a clean atmosphere outside the confined space and use a remote access probe or Tygon tubing to measure the gas concentration inside the confined space.

2) Calibration Adapter

The calibration adapter for the MiniRAE 2000 is a simple 6-inch Tygon tubing with a metal adapter on one end. During calibration, simply insert the metal adapter into the regular gas inlet probe of the MiniRAE 2000 and the tubing to the gas regulator on the gas bottle.

3) Calibration Regulator and Flow Controller

The Calibration Regulator and Flow controller is used in the calibration process. It regulates the gas flow rate from the Span gas cylinder into the gas inlet of the MiniRAE 2000 monitor during calibration process. The maximum flow rate allowed by the flow controller is about 0.5L/min (500 cc per min.). Alternatively, a Demand-flow Regulator or a Tedlar gas bag may be used to match the pump flow precisely.

4) Organic Vapor Zeroing kit (Charcoal filter)

The Organic Vapor Zeroing Kit is used for filtering organic air contaminants that may affect the zero calibration reading. To use the Organic Vapor Zeroing Kit, simply connect the filter to the inlet port of the MiniRAE 2000.

4. PROGRAMMING OF MINIRAE 2000

The MiniRAE 2000 Monitor is built with a microcomputer to provide programming flexibility. Authorized users can recalibrate the monitor, change the alarm limits, change site ID, user ID, lamp type, and real time clock, etc.

Programming is menu-driven to provide intuitive end-user operation. The display shows the menu options and the key pad used for menu selection and data entry.

4.1 Programming Mode

The programming mode allows the users to change the setups in the monitor, calibrate the monitor, modify the sensor configuration and enter user information, etc. The programming mode has four menu items. Each menu item includes several sub-menus to perform additional programming functions. Appendix A shows a more detailed menu tree structure.

Programming Menu

Calibrate/Select Gas?

Change Alarm Limits?

Change Datalog?

Change Monitor Setup?

Once inside the programming mode, the LCD will display the first menu. Each subsequent menu item can be viewed by pressing the [N/-] repeatedly until the desired menu is displayed. To enter the sub-menu of a particular menu, press [Y/+] key, the sub-menu will be displayed.

Return to Operation mode: To exit the programming mode and return to operation, press the [MODE] key once at any of the programming menu displays.

4.2 Keys for Programming Mode

The three keys perform a different set of functions during the programming mode as summarized below.

Key	Function in Programming Mode
[MODE]:	Exit menu when pressed momentarily or exit data entry mode when pressed and held for 1 second
[Y/+]:	Increase alphanumerical value for data entry or confirm (yes) for a question
[N/-]:	Decrease alphanumerical value for data entry or deny (no) for a question

4.3 Entering into Programming Mode

1. Turn on the MiniRAE 2000 monitor and wait for the “**Ready..**” message or the instantaneous reading display “**0.0 ppm**” message displayed.
2. Press and hold down both [N/-] and [MODE] keys for three seconds to enter programming mode. This delay is to prevent the user from entering programming mode by accident.
3. The first menu item “Calibrate/select Gas?” will be displayed.
4. Release both [MODE] and [N/-] keys simultaneously to start the programming mode
5. Press [N/-] key to scroll to the next menu item of the programming menu. Press [Y/+] key to select the displayed menu item.

The following Sections 4.4 - 4.7 describe the details of each menu options.

4.4 Calibrate and Select Gas

WARNINGS

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service for the first time.

For maximum safety, the accuracy of the MiniRAE 2000 should be checked by exposing it to known concentration calibration gas before each day's use.

In the first menu of the programming mode, the user can perform functions such as calibration of the MiniRAE 2000 Monitor, select default cal memories, and modify cal memories (see Table 4.4).

Table 4.4

Calibrate/Select Gas Sub-Menu
Fresh Air Cal?
Span Cal?
Select Cal Memory?
Change Span Value?
Modify Cal Memory?
Change Correction Factor?

Calibrating the MiniRAE 2000 monitor is a two-point process using “fresh air “ and the standard reference gas (also known as span gas). First a “Fresh air” calibration, which contains no detectable VOC (0.0 ppm), is used to set the zero point for the sensor. Then a standard reference gas that contains a known concentration of a given gas is used to set the second point of reference.

Note: The span value must be set prior to calibrating for fresh air or span.

The user can store calibrations for up to 8 different measurement gases. The default gas selections are as follows:

- Cal Memory #0.....Isobutylene
- Cal Memory #1.....Hexane
- Cal Memory #2.....Xylene
- Cal Memory #3.....Benzene
- Cal Memory #4.....Styrene
- Cal Memory #5.....Toluene
- Cal Memory #6.....Vinyl Chloride
- Cal Memory #7.....Custom?

Memory #0 functions differently than the other 7 memories. For Memory #0, isobutylene is always the calibration gas. When the gas is changed in Memory #0 to one of 100 other preprogrammed chemicals or to a user-defined custom gas, a correction factor is applied to all the readings. During calibration, the unit requests isobutylene gas and displays the isobutylene concentration immediately following calibration, but when the unit is returned to the normal reading mode, it displays the selected gas and applies the correction factor.

The other 7 cal memories require the same calibration gas as the measurement gas. These memories may also be modified to a preprogrammed chemical or to a user-defined custom gas. In the gas library, only the gases that can be detected by the installed UV lamp will actually be displayed. Note that although the correction factor for the new gas will be displayed and can be modified, this factor is not applied when Memories #1-7 are

used. Therefore the factor will not affect the readings in these memories.

Once each of the memories has been calibrated, the user can switch between the calibrated gases by changing the cal memory without the need to recalibrate. Or the user can switch the measurement gas in Memory #0 and the appropriate correction factor will automatically be applied without the need to recalibrate. If the gas is changed in Memories #1-7, it is necessary to recalibrate.

To change a default gas from the list above to a library or custom gas, first go to Select Cal Memory (Section 4.4.3) and then proceed to Modify Cal Memory (Section 4.4.5) to enter the desired gas. If the desired compound does not appear in the preprogrammed library, the user can use the Custom_VOC entry in the library, or the name and correction factor of any of the existing compounds can be changed as described in Section 4.4.5. A list of some 300 correction factors is given in Technical Note 106, available at the website www.raesystems.com.

4.4.1 Fresh Air Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the MiniRAE 2000 to a “fresh” air source such as from a cylinder or Tedlar bag (option accessory). The “fresh” air is clean dry air without any organic impurities. If such an air cylinder is not available, any clean ambient air without detectable contaminant or a charcoal filter can be used.

1. The first sub-menu shows: “Fresh air Cal?”
2. Make sure that the MiniRAE 2000 is connected to one of the “fresh” air sources described above.
3. Press the [Y/+] key, the display shows “zero in progress” followed by “wait..” and a countdown timer.

After about 15 seconds pause, the display will show the message “update data...zeroed... reading = X.X ppm...” Press any key or wait about 20 seconds, the monitor will return back to “Fresh air Calibration?” submenu.

4.4.2 Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar Bag, or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the MiniRAE 2000 Monitor, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

Before executing a span calibration, make sure the span value has been set correctly (see next sub-menu).

1. Make sure the monitor is connected to one of the span gas sources described above.
2. Press the [Y/+] key at the "Span Cal?" to start the calibration. The display shows the gas name and the span value of the corresponding gas.
3. The display shows "Apply gas now!" Turn on the valve of the span gas supply.

PROGRAMMING

4. Display shows “wait.... 30” with a count down timer showing the number of remaining seconds while the monitor performs the calibration.
5. To abort the calibration, press any key during the count down. The display shows “Aborted!” and return to “Span Cal?” sub-menu.
6. When the count down timer reaches 0, the display shows the calibrated value.
Note: The reading should be very close to the span gas value.
7. During calibration, the monitor waits for an increased signal before starting the countdown timer. If a minimal response is not obtained after 35 seconds, the monitor displays “No Gas!” Check the span gas valve is on and for lamp or sensor failure before trying again.
8. The calibration can be started manually by pressing any key while the “Apply gas now!” is displayed.
9. After a span calibration is completed, the display will show the message “Update Data Span Cal Done! Turn Off Gas.”
10. Turn off the flow of gas. Disconnect the calibration adapter or Tedlar bag from the MiniRAE 2000 Monitor.
11. Press any key and it returns back to “Span Gas Cal?”

4.4.3 Select Cal Memory

This function allows the user to select one of eight different memories for gas calibration and measurement. For Memories #1-7, the calibration and measurement gas is the same and no correction factor is applied. For Memory #0, the calibration gas is always isobutylene and the measurement gas may be different, in which case the correction factor for that gas is automatically applied. The default gas selections are listed in Section 4.4

1. "Select Cal Memory?" is the third sub-menu item in the Calibration sub-menu. Pressing the [Y/+] key, the display will show "Gas =" gas name followed by "Mem # x?"
2. Press [N/-] to scroll through all the memory numbers and the gas selections respectively. Press [Y/+] to accept the displayed Cal Memory number.
3. After the [Y/+] key is pressed, the display shows "Save?" Press [Y/+] key to save and proceed. Press [N/-] to discard the entry and advance to the next sub-menu.
4. If the gas in a newly selected Cal Memory number is not calibrated, the display shows "CF= x.xx". A correction factor with the value "x.xx" will be applied.
5. If the gas of a newly selected cal memory number has been calibrated previously, the display shows "Last calibrated xx/xx/xx".

4.4.4 Change Span Value

This function allows the user to change the span values of the calibration gases.

1. "Change Span Value?" is the fourth sub-menu item in the Calibration sub-menu
2. Press [Y/+], display shows the gas name and the span value. A cursor will blink at the first digit of the Span value. To modify the span gas value, go to Step 3. Otherwise, press and hold the [MODE] key for 1 second to accept the previously stored span gas value and move to the next sub-menu.
3. Starting from the left-most digit of the span gas value, use the [Y/+] or [N/-] key to change the digit value and press [MODE] key momentarily to advance to next digit. Repeat this process until all digits are entered. Press and hold the [MODE] for 1 second to exit.
4. The display shows "Save?" To accept the new value, press the [Y/+] key. Press the [N/-] key or the [MODE] key to discard the change and move to the next sub-menu.

4.4.5 Modify Cal Memory

If the current cal memory number selected is not memory 0, users will be prompted whether to modify the settings of the selected cal memory. Press [Y/+] to modify the cal memory and [N/-] to go to the next sub-menu.

Once [Y/+] is pressed the LCD display will show the current memory number, current Gas selected and prompt user for acceptance of current gas selected.

1. Press [N/-] to modify the gas selection if desired. Or press [Y/+] key to skip the change of gas selection, and proceed to the next sub-menu.
2. After pressing [N/-], display shows “Copy gas from library?” Press [Y/+] to accept or [N/-] for the next sub-menu, “Enter Custom gas?”
3. In the “Copy gas from library” submenu, use [Y/+] and [N/-] keys to scroll through the selections in the library. Press [MODE] key momentarily to select the gas. The display shows “Save?” Press [Y/+] to save or [N/-] to discard the changes and proceed to next sub-menu.
4. In the Custom gas sub-menu, the user can enter the gas name. Press the [Y/+] or [N/-] key to cycle through all 26 letters and 10 numerals. Press the [MODE] key momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all digits (up to 8 digits) of the custom gas name is entered.

Press and hold the [MODE] key for 1 second to exit the name entry mode. The display will show “Save?” Press [Y/+] to save the entry, or [N/-] to discard the changes.

4.4.6 Change Correction Factor

This function allows the user to change the Correction Factor of the standard calibration gas (only for Cal Memory #0).

1. "Change Correction Factor?" is the sixth sub-menu in the Calibration sub-menu.
2. Press [Y/+] key. Display shows the gas name, then the correction factor.

A cursor blinks at the left-most digit of the correction factor. If user wants to modify the correction factor, go to Step 3. Otherwise, press and hold the [MODE] key for 1 second to accept the previously stored correction factor value and return to the first sub-menu of the calibrate/select gas menu.

3. Starting from the left-most digit of the correction factor, use [Y/+] or [N/-] key to change the digit value and press [MODE] key momentarily to advance to the next digit, the cursor will move to the next digit to the right. Repeat this process until all digits are entered. Press and hold the [MODE] for 1 second to exit.
4. The display shows "Save?" To confirm the new value, press [Y/+] to accept the change. Press [N/-] or [MODE] to discard the change and return to the first sub-menu, Calibrate and Select Gas.

4.5 Change Alarm Limits

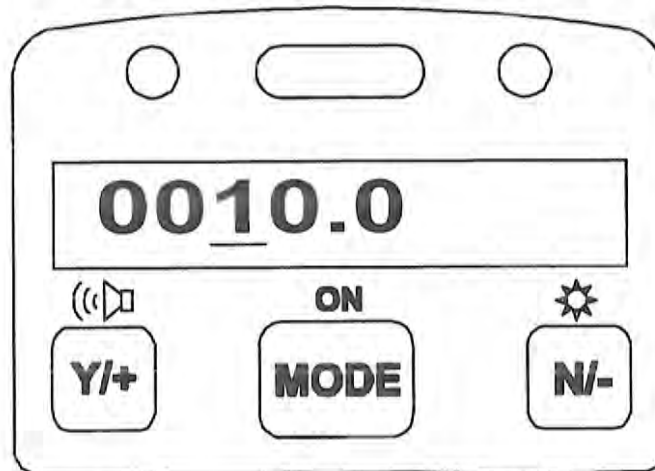
In this menu, the user can change the high and low alarm limits, the STEL limit and the TWA limit (see Table 4.5 below). Press the [Y/+] key and the display shows the current gas selected followed by the first sub-menu item below.

Table 4.5

Alarm Limit Sub-Menu
Change High Alarm limit?
Change Low Alarm limit?
Change STEL limit?
Change TWA limit?

1. Scroll through the Alarm Limit sub-menu using the [N/-] key until the display shows the desired limit to be changed, e.g., "High limit?", "STEL limit?", etc.

2. Press the [Y/+] key to select the desired limit and the display shows a flashing cursor on the left-most digit of the previously stored alarm limit.



3. To modify this limit value, use the [Y/+] or [N/-] key to change the digit value and press the [MODE] key momentarily to advance to the next digit. The flashing digit will move to the next digit to its right. Repeat this process until the new limit value is entered. Press and hold the [MODE] key for 1 second to exit data entry mode.
4. If there is any change to the existing value, the display shows "Save?" Press [Y/+] to accept the new value and move to the next sub-menu. Press [N/-] to discard the changes and move to the next sub-menu.

4.5.1 Change Low Alarm Limit

The second sub-menu item in the Alarm Limit sub-menu allows the user to change the Low Alarm limit. The LCD displays “Low limit?” To change Low Alarm limit, press [Y/+] key, or Press [N/-] key advance to next sub-menu in Table 4.5.

1. Press [Y/+] and the display will show a flashing cursor on the left-most digit of the previously stored Low alarm limit.
2. To modify this limit value, use the [Y/+] or [N/-] key to change the digit value and press the [MODE] key momentarily to advance to the next digit. The flashing digit will move to the next digit to its right. Repeat this process until the new limit values is entered. Press and hold the [MODE] key for 1 second to exit data entry mode.
3. If there is any change to the existing value, the display shows “Save?” Press [Y/+] to accept the new value and move to the next sub-menu. Press [N/-] to discard the changes and move to the next sub-menu.

4.5.2 Change STEL Limit

This sub-menu item allows the user to change the STEL limit. The display shows “STEL limit?”

1. Press the [Y/+] key and the display will show a flashing cursor on the left-most digit of the previously stored STEL limit.
2. To modify this limit value, use the [Y/+] or [N/-] key to change the digit value and press the [MODE] key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new limit values is entered. Press and hold the [MODE] key for 1 second to exit data entry mode.
3. If there is any change to the existing value, the display shows “Save?” Press [Y/+] to accept the new value and move to the next sub-menu. Press [N/-] to discard the changes and move to the next sub-menu.

4.5.3 Change TWA Limit

This sub-menu item allows the user to change the TWA limit. The LCD displays “TWA limit?”

1. Press [Y/+] and the display will show a flashing cursor on the left-most digit of the previously stored TWA limit.
2. To modify this limit value, use the [Y/+] or [N/-] key to change the digit value and press the [MODE] key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new limit values is entered. Press and hold the [MODE] key for 1 second to exit data entry mode.
3. If there is any change to the existing value, the display shows “Save?” Press [Y/+] to accept the new value and move to the next sub-menu. Press [N/-] to discard the changes and move to the next sub-menu.

4.6 Change Datalog

The MiniRAE 2000 monitor calculates and stores the concentration and ID of each sample taken. In the datalog sub-menu, a user can perform the tasks and functions shown below.

Datalog Sub-Menu

Reset Peak/Minimum?

Clear Data?

Change Data Period?

Change Average Type?

4.6.1 Reset Peak

This function will reset the peak and minimum stored in the data memory. Note: this function will not clear the STEL or TWA data.

1. “Reset Peak?” is the first sub-menu item in the Datalog sub-menu (Table 4.6).
2. Press the [Y/+] key to reset the Peak/Minimum Values. The display shows “Are You Sure?”
3. Pressing the [Y/+] key again will reset the values. The display shows “Peak/Minimum Cleared” and moves to the next submenu.
4. Press the [N/-] or [MODE] key to exit without resetting the values and move to the next sub-menu.

4.6.2 Clear Data

This function will erase all data stored in the non-volatile datalog memory. Note: This function does not change STEL, TWA, Peak, Minimum and run time values, which are stored in the regular data memory.

1. "Clear Data?" is the third sub-menu item in the Datalog sub-menu.
2. Press the [Y/+] key to clear the datalog memory. The display shows "Are you sure?"
3. Press the [Y/+] key again to confirm erasure of all the datalog memory.
4. Press the [N/-] or [MODE] key to exit without clearing the datalog memory and move to the next datalog sub-menu.

4.6.3 Change Data Period

The datalog period can be programmed from 1 to 3,600 seconds (1 hour).

1. “Change Data Period?” is the fifth sub-menu item in the Datalog sub-menu.
2. Press the [Y/+] key and the display shows “Datalog Period = XXXX” with the left-most digit flashing, where “XXXX” is the previously stored data log period.
4. To modify this period, starting from the left-most digit, use the [Y/+] or [N/-] key to change the digit value and press the [MODE] key momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all 4 digits of the new period are entered. Press and hold the [MODE] key for 1 second to exit data entry mode.
5. If there is any change to the existing value, the display will show “Save?” Press [Y/+] to accept the new value or [N/-] to discard the changes and move to the next sub-menu.

4.6.4 Change Average Type

The user can select either an 8-hour Time Weighted Average (TWA) or a running Average. The running average is simply the average of all instantaneous (1-second) readings since the measurement was started. This average may increase or decrease with time depending on the readings. The TWA is a cumulative value used to estimate the fraction of the 8-hour limit to which the user has been exposed since the start of the measurement. This value can only increase or remain constant, never decrease. Refer to Technical Note 119 for more information on how TWA is calculated.

1. “Change Average Type?” is the sixth sub-menu in the Datalog sub-menu.
2. Press the [Y/+] key to enter the function.
3. The display will show “Running Average?” or “Time Weighted Average?” depending on the current average type.
4. Press [N/-] key to toggle between the average types. Press [Y/+] key to select the displayed average type.
5. If there is any change to the existing setting, the display shows “Save?” Press [Y/+] to save the change. Press [N/-] or [MODE] to discard the change and return to the first sub-menu.

4.7 Change Monitor Setup

Several monitor specific variables can be changed in this menu. The following is a list of configuration data that can be modified by the user.

Monitor Setup Sub-Menu	Diagnostic Mode
Change Operation Mode?	“
Change Site ID?	Change Unit ID?
Change User ID?	Change Host ID?
Change Alarm Mode?	“
Change User Mode?	“
Change Date?	“
Change Time?	“
Change Lamp?	“
Change Pump Duty Cycle?	“
Change Unit?	“
Change Dilution Ratio?	“
Change Output?	“
Change DAC Range?	“
Set Temperature Unit?	“

4.7.1 Change Operation Mode

MiniRAE 2000 supports two operation modes: Survey and Hygiene mode.

Survey mode: Manual start/stop of measurements and display of certain exposure values.

Hygiene mode: Automatic measurements, running and datalogging continuously and calculates additional exposure values.

1. “Change Op Mode?” is the first sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the [Y/+] key and the display shows the current user mode: “Op Mode = *current mode*?”
3. Press the [Y/+] key to accept the currently displayed operation (Op) mode. Press [N/-] to toggle to the other operation mode. Press [MODE] to exit this sub-menu and move to the next monitor setup sub-menu.
4. When changing Op mode from Hygiene to Survey, the display shows the additional message “Warning! Exit Hygiene?” to prevent accidental exit from Hygiene mode. Press the [Y/+] key to acknowledge.
5. If there is any change to the existing setting, the display will show “Save?” Press the [Y/+] key to accept or the [N/-] key to discard and move to the next sub-menu.

Note: If a new Op Mode is saved, the display shows “Op Mode changed!!” when exiting the programming mode.

4.7.2 Change Site ID

The user can enter an 8-digit alphanumeric site ID in the programming mode. This site ID will be included in the datalog report.

1. "Change Site ID?" is the second sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the [Y/+] key and the display shows the current site ID: "Site ID = xxxxxxxx" with the left most digit flashing.
3. Press the [Y/+] or [N/-] key to cycle through all 26 letters and 10 numerals. Press [MODE] momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all 8 digits of the new site ID are entered.
4. Press and hold the [MODE] key for 1 second to exit the data entry mode.
5. If there is any change to the existing site ID, the display shows "Save?" Press the [Y/+] key to accept the new site ID. Press the [N/-] key to discard the change and move to the next sub-menu.

4.7.3 Change User ID

The user can enter an 8-digit alphanumeric user ID in the programming mode. This user ID will be included in the datalog report.

1. "Change User ID?" is the third sub-menu item the Monitor Setup menu.
2. Press the [Y/+] key and the display shows the current user ID: "User ID = xxxxxxxx" with the left most digit flashing.
3. Press the [Y/+] or [N/-] key to cycle through all 26 letters and 10 numerals. Press [MODE] momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all 8 digits of the new user ID are entered.
4. Press and hold the [MODE] key for 1 second to exit the data entry mode.
5. If there is any change to the existing user ID, the display shows "Save?" Press the [Y/+] key to accept the new user ID. Or press the [N/-] key to discard the changes and move to the next sub-menu.

4.7.4 Change Alarm Mode?

There are two different alarm modes: **Latched** and **Automatic Reset** (Auto Reset) in the MiniRAE 2000 that can be selected from the programming menu.

1. “Change Alarm Mode?” is the fourth sub-menu item in the Monitor Setup menu.
2. Press the [Y/+] key; the display shows the current alarm mode.
3. Press the [Y/+] key to accept the currently displayed alarm mode. Press [N/-] key to toggle to the other alarm mode. Press [MODE] to exit this sub-menu and move to the next monitor setup sub-menu.
4. If there is any change to the existing setting, the display will show “Save?” Press [Y/+] to save the change. Press [N/-] or [MODE] to discard the change and move to the next sub-menu.

4.7.5 Change User Mode

There are two different user modes: **Display** and **Program** that can be selected from the programming menu.

1. “Change User Mode?” is the fifth sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the [Y/+] key; the display shows the current user mode selected.
3. Press the [Y/+] key to accept the currently displayed user mode. Press [N/-] key to toggle to the alternate user modes. Press [MODE] to exit this sub-menu and move to the next monitor setup sub-menu.
4. If there is any change to the existing selection, the display shows messages “Program change” and “Are you sure?” Press [Y/+] to confirm the change or press [N/-] or [MODE] to discard the changes and move to the next sub-menu.

CAUTION: If the user mode is changed to **Display** mode, the user can no longer enter the programming mode. Therefore, the user can not change the user mode back to **Program** mode in normal mode.

To restore the user mode back to **Program** mode, turn the unit off and back on in Diagnostic Mode. Next enter Program mode by holding the [MODE] and [N/-] keys for three seconds. Enter the password at the prompt (the default is 0000). Once program mode is entered, go to the “Change Monitor Setup” / “Change User Mode” and change the mode back to **Program**.

An alternative way to change Display mode back to Program mode is through the PC and the ProRAE-Suite software.

4.7.6 Change Date

The MiniRAE 2000 monitor is equipped with a real time clock (RTC). The user can enter the correct date and time (see 4.7.7) for the real time clock.

1. "Change Date?" is the sixth sub-menu item in the Monitor Setup menu.
2. Press [Y/+] and the display shows the current date "mm / dd / yy" with the left most digit of the date flashing.
5. To modify this value, use the [Y/+] or [N/-] key to change the digit value and press the [MODE] key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new date and time values are entered. Press and hold the [MODE] key for 1 second to exit data entry mode.
4. If there is any change to the existing value, the display shows "Save?" Press [Y/+] to confirm the new value or press [N/-] or [MODE] to discard the changes and move to the next sub-menu.

4.7.7 Change Time

To change the time in the RTC of the MiniRAE 2000:

1. “Change Time?” is the seventh sub-menu item in the Monitor Setup menu.
2. Press [Y/+] and the display shows the current time in the 24-hour format “hh : mm” with the left most digit of the time flashing.
3. To modify this value, use the [Y/+] or [N/-] key to change the digit value and press the [MODE] key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new date and time values are entered. Press and hold the [MODE] key for 1 second to exit data entry mode.
4. If there is any change to the existing value, the display shows “Save?” Press [Y/+] to confirm the new value or press [N/-] or [MODE] to discard the changes and move to the next sub-menu.

4.7.8 Change Lamp

There are three UV lamps with different photon energies available for the PID sensor: **9.8 eV**, **10.6 eV** and **11.7 eV**. The user can select any one of the lamps from the programming mode.

1. “Change Lamp Type?” is the eighth sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the **[Y/+]** key; the display shows the current PID lamp selection.
3. Press the **[Y/+]** key to accept the currently displayed lamp. Press **[N/-]** key to scroll through the sub-menu for other lamp selections. Press **[MODE]** to exit this sub-menu and return to the next sub-menu in Table 4.7.
4. If there is any change to the existing selection, the display will show “Save?” Press **[Y/+]** to save the new selection or press **[N/-]** or **[MODE]** to discard the change and return to the next sub-menu in Table 4.7.

4.7.9 Change Unit

User can change the display and datalog unit from parts per million (ppm) to milli-gram per cubic meter (mg/m^3).

1. "Change Unit?" is the ninth sub-menu item in the Monitor Setup sub-menu.
2. Press the [Y/+] key, the display should show the current unit "Display Unit = ppm?" or "Display Unit = mg/m^3 ?"
3. Press [Y/+] key to accept the currently displayed unit. Press [N/-] key to toggle to the other unit. Press [MODE] key to exit this sub-menu.
4. If there is any change to the existing selection, press [Y/+] to confirm the new selection or press [N/-] or [MODE] to discard the changes and move to the next sub-menu.

Caution:

1. **The correction factor in the gas library is calculated based on "ppm" unit. If "mg" unit is selected, the built-in correction factor library is not valid.**
2. **No automatic conversion between "ppm" and " mg/m^3 " reading is performed by the monitor.**
3. **When the unit name is changed from "ppm" to "mg", the unit must be recalibrated with the span gas concentration entered in mg/m^3 . The converse rule applies when the unit is changed from "mg" to "ppm".**

4.7.10 Change Dilution Ratio

If a dilution system is used upstream of the MiniRAE 2000 inlet port, the user can enter the dilution ratio (from 1 to 10) to compensate the readings. The unit will then display the actual concentration of the gas before dilution. The dilution ratio should be 1 in normal operation where no dilution gas is applied to the sample gas. Dilution improves accuracy and linearity when the concentrations are above a few thousand ppm.

1. "Change Dilution Ratio?" is the tenth sub-menu item in the Monitor Setup menu.
2. Press the [Y/+] key; the display shows the current dilution ratio: "Dilution Ratio = xx" with the left most digit flashing.
3. Press the [Y/+] or [N/-] key to increase or decrease the value of the digit. Press [MODE] momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until both digits of the new dilution ratio are entered.
4. Press and hold the [MODE] key for 1 second to exit the data entry mode and move to the next sub-menu.
5. If there is any change to the existing dilution ratio, the display shows "Save?" Press [Y/+] to confirm the new value or press [N/-] or [MODE] to discard the changes and move to the next sub-menu.

4.7.11 Change Output?

There are two different external output options: DAC (Analog output) and Alarm in the MiniRAE 2000 that can be selected from the programming menu. The alarm output can be used to connect to the optional vibration alarm (vibrator) only. The analog output, which is proportional to the gas concentration, can be connected a chart recorder or can be queried by a computer to download data in real time (see Technical Note 141).

1. "Change External Output?" is the eleventh sub-menu item in the Monitor Setup menu.
2. Press the [Y/+] key and the display shows the current output option selection: "Output = DAC?"
3. Press the [Y/+] key to accept the currently displayed output option. Press [N/-] to change to the other external option: "Output = Alarm?" Press [MODE] to exit this sub-menu and move to the next monitor setup sub-menu.
4. If there is any change to the existing selection the display will show "Save?" Then, press [Y/+] to save the change, press [N/-] to go back to Step 2, or press [MODE] to exit this sub-menu and move to the next monitor setup sub-menu.

4.7.12 Change DAC Range?

There are four different DAC (Digital-to-Analog Conversion) range values available in the **MiniRAE 2000: 20, 200, 2000 and 10K ppm**. The maximum 2.5V DC analog signal output from the unit will represent the range value chosen. (See for analog signal output connection.)

1. “Change DAC Range?” is the twelfth sub-menu item in the Monitor Setup menu.
2. Press the [Y/+] key, the display shows the current DAC Range value: “DAC Range = 2000 ppm?”
3. Press the [Y/+] key to accept the currently displayed value. Press [N/-] to scroll through the sub-menu for other range values. Press [MODE] to exit this sub-menu and return to the first sub-menu in Table 4.7.
4. If there is any change to the existing selection, press the [Y/+] key and the display will show “Save?” Press the [Y/+] key to save the change or press the [N/-] key to discard and return to the first sub-menu in Table 4.7.

4.7.13 Set Temperature Unit?

The temperature display can be switched between Fahrenheit and Celsius units.

1. "Set Temperature Unit?" is the thirteenth sub-menu item in the Monitor Setup menu.
2. Press the [Y/+] key, and the display shows the current setting: "Temperature Unit = Fahrenheit?"
3. Press the [Y/+] key to accept the currently displayed value. Press [N/-] to select the sub-menu "Temperature Unit = Celsius?" Press [MODE] to exit this sub-menu and return to the first sub-menu in Table 4.7.
4. If there is any change to the existing selection, press the [Y/+] key and the display will show "Save?" Press the [Y/+] key to save the change and return to the first sub-menu in Table 4.7 or press the [N/-] key to discard and return to Step 3..

4.8 Exit Programming Mode

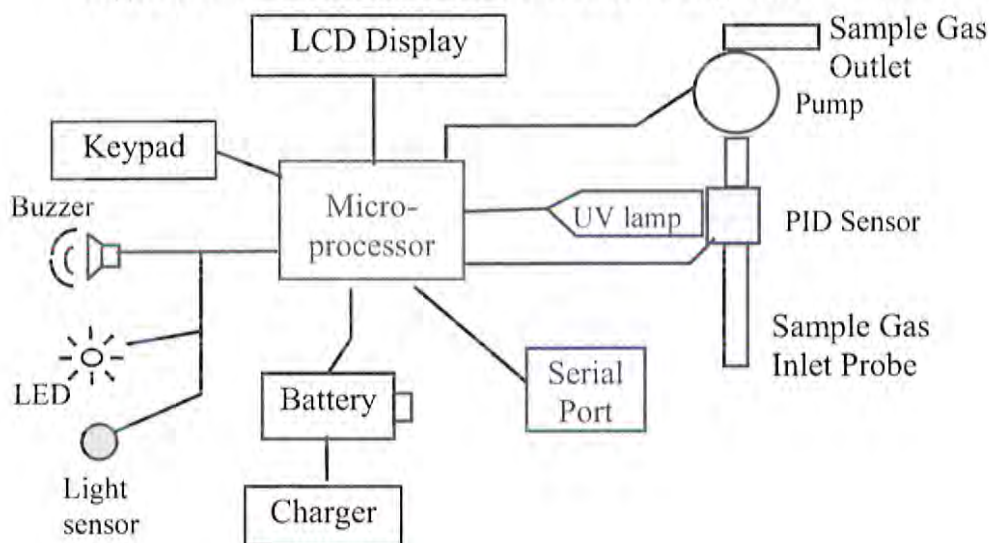
1. To exit programming mode from the first tier menu level, press the **[MODE]** key once.
2. To exit programming mode from 2nd tier sub-menu, press the **[MODE]** key twice.
3. To return to programming mode, press and hold down both the **[MODE]** and **[N/-]** keys for 3 seconds.

5. THEORY OF OPERATION

The MiniRAE 2000 monitor uses a newly developed electrodeless discharge UV lamp as the high-energy photon source for the PID. As organic vapors pass by the lamp, they are photo-ionized and the ejected electrons are detected as a current. The PID sensor with a standard 10.6 eV lamp detects a broad range of organic vapors. A lamp with high photon energy (e.g. 11.7 eV) will measure the more kinds of compounds, whereas low photon energies (e.g. 9.8 eV) are selective for easily ionizable compounds such as aromatics. In principle, any compound with an ionization energy lower than that of the lamp photons can be measured.

The PID sensor for the MiniRAE 2000 monitor is constructed as a small cavity in front of the UV lamp. A diaphragm pump draws the gas sample into the sensor and then pumps it out through the side of the instrument.

Figure 5-1 MiniRAE 2000 Block Diagram



THEORY OF OPERATION

A single chip microcomputer is used to control the operation of the alarm buzzer, LED, pump and light sensor. It measures the sensor readings and calculates the gas concentrations based on calibration to known standard gases. The data are stored in non-volatile memory so that they can be sent to a PC for record keeping. RS-232 transceivers provide a serial interface between the monitor and the serial port of a PC. An LCD display consisting of a single row of eight alpha/numeric characters is used to display the readings. The user interacts with the monitor through three keys on the front panel keypad.

A rechargeable NiMH, NiCd battery, or an alkaline battery pack powers the monitor.

6. MAINTENANCE

The major maintenance items of the MiniRAE 2000 are:

- Battery pack
- Sensor module
- PID lamp
- Sampling pump
- Inlet connectors and filters

Note: Maintenance should be performed by qualified personnel only.

NOTE: The printed circuit board of the monitor is connected to the battery pack even if the power is turned off. Therefore, it is very important to disconnect the battery pack before servicing or replacing any components inside the monitor. Severe damage to the printed circuit board or battery may occur if the battery pack is not disconnected before servicing the unit.

6.1 Battery Charging and Replacement

When the display shows a flashing message “Bat”, the battery requires recharging (see Section 3.1 for Battery charging). It is recommended to recharge the MiniRAE 2000 monitor upon returning from fieldwork. A fully charged battery runs a MiniRAE 2000 monitor for 10 hours continuously. The charging time is less than 10 hours for a fully discharged battery. The built-in charging circuit is controlled by the micro-controller to prevent over-charging. The battery may be replaced in the field (in area known to be non-hazardous) if required.

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non- hazardous. Remove and replace battery only in area known to be non-hazardous.

Replacing Battery Pack

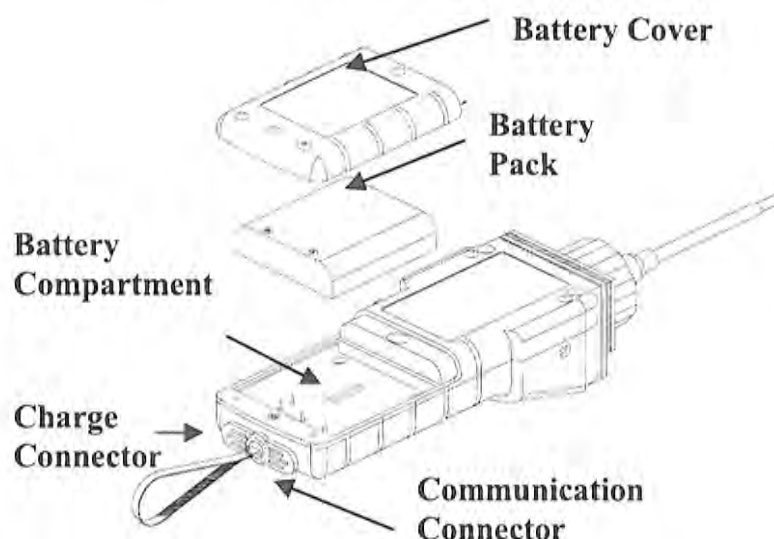


Figure 6-1 Battery Replacement

1.

Turn off the power of the MiniRAE 2000.

2. Unscrew the two battery compartment screws, located on the bottom of the monitor, and remove the cover.
3. Remove the battery pack from the battery compartment.
4. Replace a fully charged spare battery pack inside the battery compartment. Make sure the battery pack is oriented properly inside the compartment
5. Close the battery cover and tighten the two screws.

Replacing Alkaline Battery Adapter

1. Insert four fresh AA size alkaline batteries into the alkaline battery holder. Make sure that the polarity of the batteries is correct.
2. Follow the same procedure as described above to replace the battery holder.

Note: The internal charging circuit is designed to prevent charging to alkaline batteries.

6.2 PID Sensor & Lamp Cleaning/Replacement

The sensor module is made of several components and is attached to the lamp-housing unit as shown in Figure 7-2.

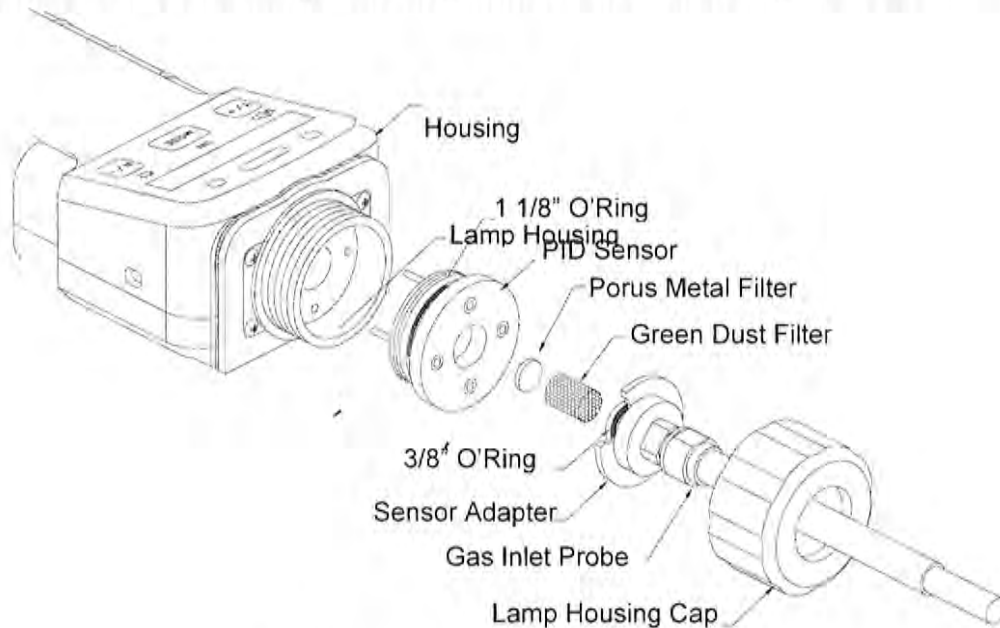


Figure 7-2 Sensor Components

Note: Normally the cleaning procedure is not needed. Clean the PID sensor module, the lamp and the lamp housing only when one of the following happened:

1. The reading is inaccurate even after calibration.
2. The reading is very sensitive to air moisture.
3. A chemical liquid has been sucked into the unit and damaged the unit.

Use of the water trap filter will help prevent contamination and accidentally drawing liquid into the sensor.

To access the sensor components and lamp, gently unscrew the lamp-housing cap, remove the sensor adapter with the gas inlet probe and the metal filter all together. Then hold the PID sensor and pull straight out to avoid bending the electrical pins on the sensor (see Figure 7-2). A slight, gentle rocking motion helps release the sensor.

To clean the PID sensor:

Place the entire PID sensor module into GC grade methanol. It is highly recommended that an ultrasound bath to be used to clean the sensor for at least 15 minutes. Then dry the sensor thoroughly. Never touch the electrodes of the sensor by hand.

Also use a methanol-soaked cotton swab to wipe off the lamp housing where it contacts the sensor when the sensor is installed.

Turn over the sensor so that the pins point up and the sensor cavity is visible. Examine the sensor electrodes for any corrosion, damage, or bending out of alignment. The metal sensor electrode “fingers” should be flat and straight. If necessary, carefully bend the sensor fingers to ensure that they do not touch the Teflon portions and that they are parallel to each other. Make sure that the nuts on the sensor pins are snug but not overtight. If the sensor is corroded or otherwise damaged, it should be replaced.

To clean lamp housing or change the lamp:

To clean lamp housing or change the lamp:

If the lamp does not turn on, the monitor will display an error message to indicate replacement of the lamp may be required.

1. If the lamp is operational, clean the lamp window surface and the lamp housing by wiping it with GC grade methanol using a cotton swab using moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean. Never use water solutions to clean the lamp. Dry the lamp and the lamp housing thoroughly after cleaning.

CAUTION: Never touch the window surface with the fingers or anything else that may leave a film. Never use acetone or aqueous solutions.

2. If the lamp does not turn on, remove the lamp from the lamp housing. Place the lamp O-ring onto the new lamp. Insert the new lamp, avoiding contact with the flat window surface.
3. Reinstall the PID sensor module.
4. Tighten the Lamp Housing Cap.
5. If the lamp type has been changed, adjust the lamp type setting in the programming mode (Section 4.7.8).

6.3 Sampling Pump

When approaching the end of the specified lifetime of the pump, it will consume higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace or rebuild the pump. When checking the pump flow, make sure that the inlet connector is tight and the inlet tubing is in good condition. Connect a flow meter to the gas inlet probe. The flow rate should be above 450 cc/min when there is no air leakage.

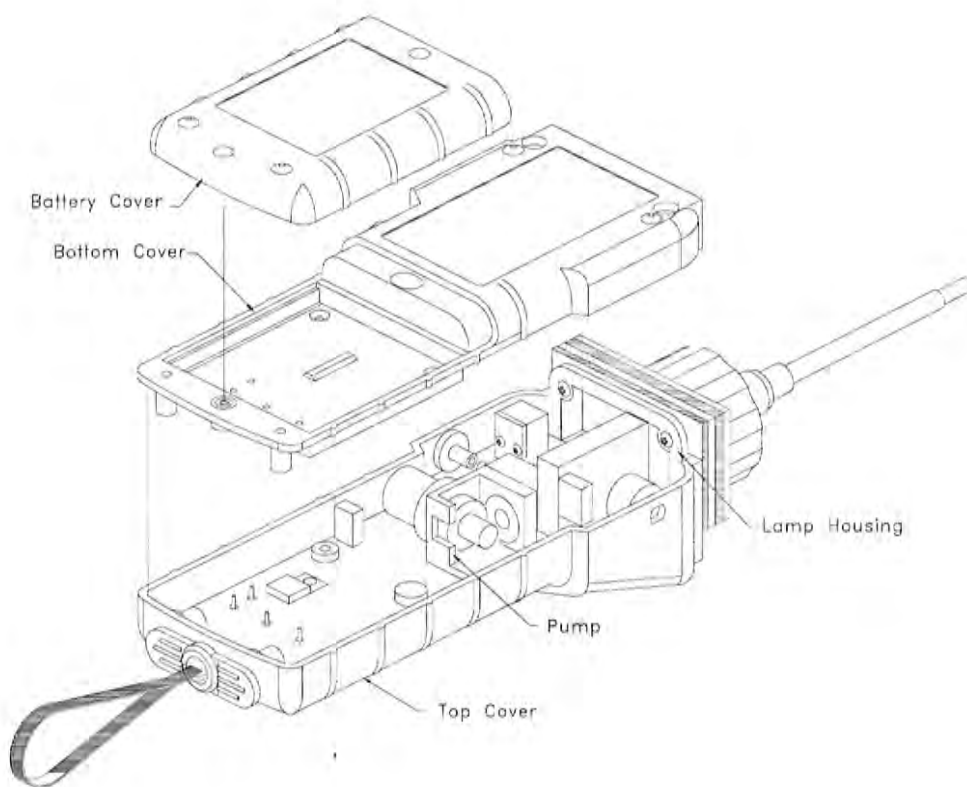


Figure 7-3 Sampling Pump

Pump Replacement

1. Turn off the MiniRAE 2000 power.
2. Open the battery cover, remove the battery pack, and carefully unscrew the six screws to open the bottom cover.
3. Unplug the pump from the PCB. Unscrew the two screws that hold the pump assembly to the PCB. Disconnect the Tygon tubing that connects the pump to the gas inlet port and gas outlet port.
4. Insert a new pump assembly. Connect the Tygon tubing to the gas inlet port. Plug the pump connector back into the PCB and screw down the pump assembly to the board.
5. Replace the bottom cover and tighten the six screws. Reconnect the battery pack. Replace the battery pack and its cover.

6.4 Turning on the UV Lamp

The UV lamp is made of a glass envelope and a UV window (salt crystal) on one end of the envelope. The inside of the lamp is filled with low pressure gases. To turn on the lamp, a high voltage electric field is applied from the outside of the glass envelope. The molecules inside the lamp are ionized and produce a glow discharge that generates the UV light. The MiniRAE 2000 has a built-in sensing mechanism to monitor the status of the UV lamp and display a “Lamp” error message if it is not on.

If the UV lamp has not been used for a long period of time (> 1 month) or is cold, it may become slightly harder to turn on. If such a condition occurs, the “Lamp” message will appear in the monitor display during the power on sequence. This phenomenon is more significant in 0.25” UV lamps used in ToxiRAE and MultiRAE Plus products, because of the relatively small lamp size. To solve this problem, simply turn on and off the monitor a few times and the lamp should turn on. After the UV lamp is turned on for the first time, it should be easier to turn on the UV lamp next time.

It is possible that the UV lamp is actually on when the lamp error message appears. This is because when the lamp becomes old, the internal threshold level to detect lamp failure may have shifted and cause a false alarm. To eliminate such possibility, simply check to see the UV lamp is actually on. This can be done easily by removing the sensor cap and observing the glow light of the UV lamp in a dark place. The user can also feed the monitor with calibration gas and observe if the sensor reading changes. If the reading changes significantly with the gas, the UV lamp is actually on.

A possible failure mechanism for the UV lamp is a leak developed along the seal of the glass envelope. When such condition occurs, the lamp will become very hard or impossible to turn on and will need to be replaced.

7. TROUBLESHOOTING

To aid the user in diagnosing the monitor, a special diagnostic mode can be used displays critical, low level parameters. Section 7.1 describes the operation of the diagnostic mode. Section 7.2 summarizes the frequently encountered problems and suggested solutions. By turning on the MiniRAE 2000 monitor in diagnostic mode and by using the troubleshooting table in Section 7.2, the user can usually correct the problem without having to return the monitor for repair.

WARNING

This function should be used by qualified personnel only! The diagnostic mode allows the user to set several low-level parameters that are very critical to the operation of the monitor. Extra care should be taken when setting these parameters. If the user is not familiar with the function of these parameters and sets them incorrectly, it may cause the monitor to shut down or malfunction.

7.1 Troubleshooting Table

Problem	Possible Reasons & Solutions
Cannot turn on power after charging the battery	<p>Reasons: Discharged battery. Defective battery. Microcomputer hang-up.</p> <p>Solutions: Charge or replace battery. Disconnect, then connect battery to reset computer.</p>
No LCD back light	<p>Reasons: Trigger level too low, the current mode is not user mode, and the mode does not support automatic turn on back light.</p> <p>Solutions: Adjust trigger level. Verify the back light can be turned on in user mode. Call authorized service center.</p>
Lost password	<p>Solutions: Call Technical Support at +1.408 .752 .0723 or +1. 888 .723 .4800</p>
Reading abnormally High	<p>Reasons: Dirty sensor module. Dirty water trap filter. Excessive moisture and water condensation.</p> <p>Solutions: Clean sensor module and lamp housing. Replace water trap filter. Blow dry the sensor module.</p>
Buzzer Inoperative	<p>Reasons: Bad buzzer.</p> <p>Solutions: Call authorized service center.</p>

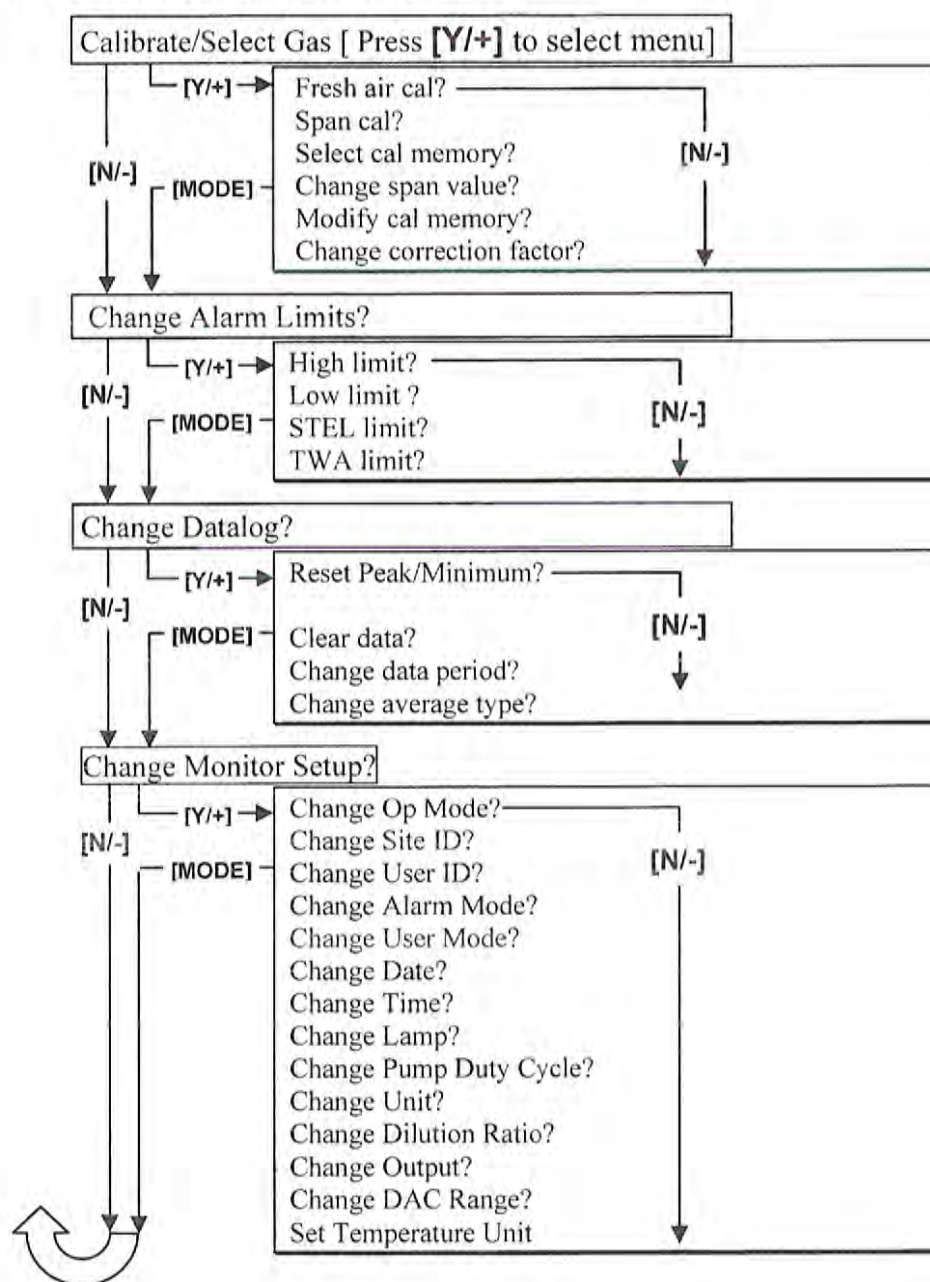
TROUBLESHOOTING

Inlet flow too low	<p>Reasons: Pump diaphragm damaged or has debris. Flow path leaks.</p> <p>Solutions: Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Replace pump or diaphragm.</p>
“Lamp” message during operation	<p>Reasons: Lamp drive circuit. Weak or defective PID lamp, defective.</p> <p>Solutions: Turn the unit off and back on Replace UV lamp</p>
Full scale measurement in humid environment	<p>Reasons: Dirty or wet sensor.</p> <p>Solutions: Clean and dry sensor and lamp housing. Adjust sensor fingers to ensure not touching Teflon. Use water trap filter.</p>
Reading abnormally low	<p>Reasons: Incorrect calibration. Low sensitivity to the specific gas. Weak or dirty lamp. Air leakage.</p> <p>Solutions: Calibrate the monitor. Replace sensor. Clean or replace lamp. Check air leakage.</p>

APPENDIX A. QUICK REFERENCE GUIDE

Press [N/-] and [MODE], simultaneously, for 3 seconds, to enter Programming Mode. Press [MODE] to return to Survey Mode.

PROGRAMMING MODE



RAE Systems, Inc. Contact Information

Main Office: 3775 N. First St.
San Jose, CA 95134-1708
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Telephone: 408-952-8200

Fax: 408-952-8480

Instrument Sales: 877-723-2878

Email: RaeSales@raesystems.com

Website: www.raesystems.com

Technical Service: 888-723-4800

Tech@raesystems.com

Special Note

If the monitor needs to be serviced, contact either:

1. The RAE Systems distributor from whom the monitor was purchased; they will return the monitor on your behalf.
2. The RAE Systems Technical Service Department. Before returning the monitor for service or repair, obtain a Returned Material Authorization (RMA) number for proper tracking of your equipment. This number needs to be on all documentation and posted on the outside of the box in which the monitor is returned for service or upgrade. Packages without RMA Numbers will be refused at the factory.

General Guidance for Monitoring Well Installation

I. Purpose

To provide site personnel with a review of the well installation procedures that will be performed. These procedures are to be considered general guidelines only and are in no way intended to supplement or replace the contractual specifications in the driller's subcontract.

II. Scope

Monitoring well installations are planned for shallow and/or deep unconsolidated aquifers and/or for bedrock aquifers. The SOPs *Installation of Shallow Monitoring Wells*, *Installation of Surface-Cased Monitoring Wells*, *Installation of Bedrock Monitoring Wells*, and *Installation of Monitoring Wells Using Sonic Drilling* provide more specifics.

III. Equipment and Materials

1. Drilling rig (hollow stem auger, sonic, air hammer, air rotary, or mud rotary)
2. Well-construction materials (i.e., surface casing, screens, riser, casing, caps, bottom plugs, centering guides, sand, bentonite, grout, and surface-finish materials)
3. Development equipment

IV. Procedures and Guidelines

1. Wells will be installed in accordance with standard EPA procedures. Note that USEPA Region III requires any well penetrating a confining layer to be double-cased.
2. The threaded connections will be water-tight.
3. Well screens generally will be constructed of 10-slot or 20-slot Schedule 40 PVC and will be 5 to 10 feet in length depending on saturated thickness of unconsolidated sediments. The exact slot size and length will be determined by the field team supervisor. Stainless steel may be required under certain contaminant conditions.
4. Stick-up wells will be surrounded by four concrete-filled guard posts at least 2 inches in diameter.

5. A record of the finished well construction will be compiled.
6. All soils and liquids generated during well installations will be drummed for proper disposal.

Monitoring Well Installation

- 2" monitoring wells in unconsolidated materials will be installed in at least 6-inch-diameter boreholes to accommodate well completion materials in designated locations.
- All monitoring wells penetrating a confining layer will be surface-cased from the ground surface to approximately 5 feet into the confining layer. Exceptions to this may be allowed under certain circumstances (e.g., evidence of significant natural gaps in the confining layer).
- Monitoring wells in unconsolidated materials will be constructed of 2-inch-diameter, factory manufactured, flush-jointed, Schedule 40 PVC (or stainless steel) screen with threaded bottom plug and riser.
- Screens will be filter packed with a properly sized and graded, thoroughly washed, sound, durable, well-rounded basalt or siliceous sand. When using hollow-stem augers, the filter pack will be installed by slowly pouring the sand into the annular space while simultaneously raising the augers and using a weighted tape to sound for the sand surface. For rotary-drilled wells, the height of the sand pack also will be sounded with a weighted tape.
- The primary filter sand pack (typically Morie #00 or DSI #1 for a 10-slot screen) will extend from 1 to 2 feet below the base to 2 feet above the top of the screen; filter pack will be allowed to settle before final measurement is taken. For wells deeper than 30 feet, the filter pack will be placed using a tremie pipe and flowing water.
- A secondary filter sand pack (typically a fine sand seal) 1-foot thick may be placed above the primary sand pack.
- Annular well seals will consist of 2 feet of pelletized, chip, or granular bentonite clay placed above the filter pack. If necessary the pellets will be hydrated using potable water. For wells installed using hollow-stem augers, the bentonite will be poured into the annular space while slowly raising the augers and sounding for the top of the bentonite with a weighted tape. A high-solids bentonite slurry using powdered bentonite introduced with a side-discharging tremie pipe will be used for the bentonite seals in wells greater than 30 feet deep. For rotary-drilled wells, the height of the well seal also will be sounded with a weighted tape. High-solids slurries will have solids content of at least 20 percent.
- The top of the annular seal will be measured after the bentonite seal has been allowed to hydrate and before the grout is applied. The seal will be allowed to hydrate for at least 30 minutes before work in the well continues.

- The annular space above the bentonite seal will be filled to grade with a bentonite-cement slurry grout mixture.
- The grout mixture consists of 6 to 8 gallons of water per 94-pound bag of Portland cement; 3 to 6 pounds of bentonite added per bag of cement to reduce shrinkage.
- The grout mix will be carefully applied to avoid disturbing the bentonite seal; the method of grout placement must force grout from the top of the bentonite seal to ground surface.
- After allowing the grout to settle and set up overnight, additional grout will be added to maintain grade.
- A protective steel casing equipped with keyed alike locking caps will be grouted in place for each new well; the casing will extend at least 2 feet above grade and 3 feet below grade, and will be painted a bright color.

Well Development

- New monitoring wells will be developed after the well has been completely installed and the grout has hardened (at least 24 hours)
- The well will be developed by surging and pumping.
- Equipment placed in the well will be decontaminated before use.
- If information is available, begin developing in the least-contaminated well first.
- Development will include surging the well by either abruptly stopping flow and allowing water in the well column to fall back into the well or through the use of a surge block that is slightly smaller in diameter than the well casing inner diameter.
- Pipes and pumps must not be fitted with foot valves or other devices that might inhibit the return flow of water to the well.
- Surging should continue throughout the development process.
- The air-lift method may be used to pump materials out of the well. The air compressor will be fitted with filters to remove all oil and the air lift hose used will be made of inert materials.
- Well development will continue until the water produced is free of turbidity, sand, and silt. A Horiba-U22 meter, YSI meter with separate Hanna turbidity meter, or equivalent should be used to determine when the turbidity is low and parameters have stabilized.
- Development water will be considered hazardous and placed in sealed 55-gallon U.S. DOT approved steel drums. CH2M HILL will label and date the drums as pending analysis, and transport the drums to a designated site for storage.

V. Attachments

None.

VI. Key Check and Items

- Ensure that all equipment is properly decontaminated as needed.
- Only new, sealed materials (e.g., screens, risers, and sand) will be used in constructing the well.
- Care shall be taken when making downhole measurements to ensure that proper heights of sand, seal, and grout are achieved.

Logging of Soil Borings

I. Purpose and Scope

This SOP provides guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. The characterization is based on visual examination and manual tests, not on laboratory determinations.

II. Equipment and Materials

- Indelible pens
- Tape measure or ruler
- Field logbook
- Spatula
- HCL, 10 percent solution
- Squirt bottle with water
- Rock- or soil-color chart (e.g., Munsell)
- Grain-size chart
- Hand lens
- Unified Soil Classification System (USCS) index charts and tables to help with soil classification (attached)

III. Procedures and Guidelines

This section covers several aspects of soil characterization: instructions for completing the CH2M HILL soil boring log Form D1586 (attached), field classification of soil, and standard penetration test procedures.

A. Instructions for Completing Soil Boring Logs

Soil boring logs will be completed in the field log books or on separate soil boring log sheets. Information collected will be consistent with that required for Form D1586 (attached), a standard CH2M HILL form (attached), or an equivalent form that supplies the same information.

The information collected in the field to perform the soil characterization is described below.

Field personnel should review completed logs for accuracy, clarity, and thoroughness of detail. Samples also should be checked to see that information is correctly recorded on both jar lids and labels and on the log sheets.

B. Heading Information

Boring/Well Number. Enter the boring/well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

Location. If station, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as "approximate" or "estimated" as appropriate.

Elevation. Elevation will be determined at the conclusion of field activities through a survey.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger). Information on the drilling equipment (e.g., CME 55, Mobile B61) also is noted.

Water Level and Date. Enter the depth below ground surface to the apparent water level in the borehole. The information should be recorded as a comment. If free water is not encountered during drilling or cannot be detected because of the drilling method, this information should be noted. Record date and time of day (for tides, river stage) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day should be added if several borings are performed on the same day.

Logger. Enter the first and last name.

C. Technical Data

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Note the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. SS-1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest 0.1-foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement. Record soil recovery in feet.

Standard Penetration Test Results. In this column, enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the middle two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, 4, and 5 is recorded as 2-3-4-5 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of less than 6 inches with a blow count of 50. A

partial penetration of 50 blows for 4 inches is recorded as 50/4 inches. Penetration by the weight of the slide hammer only is recorded as "WOH."

Samples should be collected using a 140-pound hammer and 2-inch diameter split spoons. Samples may be collected using direct push sampling equipment. However, blow counts will not be available. A pocket penetrometer may be used instead to determine relative soil density of fine grained materials (silts and clays).

Sample also may be collected using a 300-pound hammer or 3-inch-diameter split-spoon samples at the site. However, use of either of these sample collection devices invalidates standard penetration test results and should be noted in the comments section of the log. The 300-pound hammer should only be used for collection of 3-inch-diameter split-spoon samples. Blow counts should be recorded for collection of samples using either a 3-inch split-spoon, or a 300-pound hammer. An "N" value need not be calculated.

Soil Description. The soil classification should follow the format described in the "Field Classification of Soil" subsection below.

Comments. Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). In addition, note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Health and safety monitoring data
- Drilling interval through a boulder

D. Field Classification of Soil

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488, Visual-Manual Procedure for Description and Identification of Soils (attached).

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests. It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil

description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Soil descriptions must be recorded for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488 Group Name) with appropriate modifiers. Soil name should be in all capitals in the log, for example "POORLY-GRADED SAND."
2. Group symbol, in parentheses, for example, "(SP)."
3. Color, using Munsell color designation
4. Moisture content
5. Relative density or consistency
6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488.

E. Soil Name

The basic name of a soil should be the ASTM D 2488 Group Name on the basis of visual estimates of gradation and plasticity. The soil name should be capitalized.

Examples of acceptable soil names are illustrated by the following descriptions:

- A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, and 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).
- Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488. There is no need to further document the gradation. However, the maximum size and angularity or roundness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as “Interlayered Sand and Silt,” should be used. In addition, the relative proportion of each soil type should be indicated (see Table 1 for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488.

F. Group Symbol

The appropriate group symbol from ASTM D 2488 must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

G. Color

The color of a soil must be given. The color description should be based on the Munsell system. The color name and the hue, value, and chroma should be given.

H. Moisture Content

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on Table 2.

I. Relative Density or Consistency

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586 [attached]). If the presence of large gravel, disturbance of the sample, or non-standard sample collection makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in Tables 3 and 4.

J. Soil Structure, Mineralogy, and Other Descriptors

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information such as cementation, abundant mica, or unusual mineralogy should be described.

Other descriptors may include particle size range or percentages, particle angularity or shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and staining, as well as other information such as organic debris, odor, or presence of free product.

K. Equipment and Calibration

Before starting the testing, the equipment should be inspected for compliance with the requirements of ASTM D 1586. The split-barrel sampler should measure 2-inch or 3-inch O.D., and should have a split tube at least 18 inches long. The minimum size sampler rod allowed is "A" rod (1-5/8-inch O.D.). A stiffer rod, such as an "N" rod (2-5/8-inch O.D.), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound or 300-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

IV. Attachments

Soil Boring Log (Sample Soil Boring Log.xls)

CH2M HILL Form D1586 and a completed example (Soil_Log_Examp.pdf)

ASTM D 2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* (ASTM D2488.pdf)

ASTM 1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* (ASTM D1586.pdf)

Tables 1 through 4 (Tables 1-4.pdf)

V. Key Checks and Preventive Maintenance

- Check entries to the soil-boring log and field logbook in the field; because the samples will be disposed of at the end of fieldwork, confirmation and corrections cannot be made later.
- Check that sample numbers and intervals are properly specified.
- Check that drilling and sampling equipment is decontaminated using the procedures defined in SOP *Decontamination of Drilling Rigs and Equipment*.

Sediment Sampling

I. Purpose

These general outlines describe the collection and handling of sediment samples during field operations.

II. Scope

The sediment sampling procedures generally describe the equipment and techniques needed to collect representative sediment samples. Operators manual, if available, should be consulted for specific details

III. Equipment and Materials

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device)
- Stainless steel spoon or spatula or plastic disposable scoop for media transfer
- Measuring tape
- Log book
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.)
- Materials for classifying soils, particularly the percentage of fines
- Sample jars, including jars for Total Organic Carbon and pH, as appropriate

IV. Procedures and Guidelines

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.
2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc).

3. Note in the field book any possible outside sources of contamination; for example, the outlet to a drainage culvert in the water body near your sampling location.
4. Transfer sample into appropriate sample jars with a stainless steel utensil or plastic disposable scoop. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.
5. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.
6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.
7. Sample sediment for TOC and pH also, to give context to organic and inorganic data during the risk assessment.
8. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.
9. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. Attachments

None.

VI. Key Checks and Items

- Start downstream, work upstream.
- Log exact locations using permanent features.
- Beware of hidden hazards.

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

The purpose of this guideline is to describe the packaging and shipping of low-concentration samples of various media to a laboratory for analysis.

II. Scope

The guideline only discusses the packaging and shipping of samples that are anticipated to have low concentrations of chemical constituents. Whether or not samples should be classified as low-concentration or otherwise will depend upon the site history, observation of the samples in the field, odor, and photoionization-detector readings.

If the site is known to have produced high-concentration samples in the past or the sampler suspects that high concentrations of contaminants might be present in the samples, then the sampler should conservatively assume that the samples cannot be classified as low-concentration. Samples that are anticipated to have medium to high concentrations of constituents should be packaged and shipped accordingly.

If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

III. Equipment and Materials

- Coolers
- Clear tape
- "This Side Up" labels
- "Fragile" labels
- Vermiculite
- Ziplock bags or bubble wrap
- Ice
- Chain-of-Custody form (completed)
- Custody seals

IV. Procedures and Guidelines

Low-Concentration Samples

- A. Prepare coolers for shipment:
 - Tape drains shut.
 - Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.
 - Place mailing label with laboratory address on top of coolers.
 - Fill bottom of coolers with about 3 inches of vermiculite or absorbent pads.
- B. Arrange decontaminated sample containers in groups by sample number. Consolidate VOC samples into one cooler to minimize the need for trip blanks.
- C. Affix appropriate adhesive sample labels to each container. Protect with clear label protection tape.
- D. Seal each sample bottle within a separate ziplock plastic bag or bubble wrap, if available. Tape the bag around bottle. Sample label should be visible through the bag.
- E. Arrange sample bottles in coolers so that they do not touch.
- F. If ice is required to preserve the samples, cubes should be repackaged in zip-lock bags and placed on and around the containers.
- G. Fill remaining spaces with vermiculite or absorbent pads.
- H. Complete and sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express or the courier.
- J. Close lid and latch.
- K. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.
- L. Tape cooler shut on both ends, making several complete revolutions with strapping tape. Cover custody seals with tape to avoid seals being able to be peeled from the cooler.
- M. Relinquish to Federal Express or to a courier arranged with the laboratory. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.

Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with potential additional restrictions. If applicable, the sample handler must refer to instructions associated with the shipping of dangerous goods for the necessary procedures for shipping by Federal Express or other overnight carrier. If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

V. Attachments

None.

VI. Key Checks and Items

- Be sure laboratory address is correct on the mailing label
- Pack sample bottles carefully, with adequate vermiculite or other packaging and without allowing bottles to touch
- Be sure there is adequate ice
- Include chain-of-custody form
- Include custody seals

Soil Sampling

I. Purpose and Scope

The purpose of this procedure is to provide guidelines for obtaining samples of surface and subsurface soils using hand and drilling-rig mounted equipment.

II. Equipment and Materials

- Stainless-steel trowel, shovel, scoop, coring device, hand auger, or other appropriate hand tool
- Stainless-steel, split-spoon samplers
- Thin-walled sampling tubes
- Drilling rig or soil-coring rig
- Stainless-steel pan/bowl or disposable sealable bags
- Sample bottles

III. Procedures and Guidelines

Before sampling begins, equipment will be decontaminated using the procedures described in SOP *Decontamination of Drilling Rigs and Equipment*. The sampling point is located and recorded in the field logbook. Debris should be cleared from the sampling location.

A. Surface and Shallow Subsurface Sampling

A shovel, post-hole digger, or other tool can be used to remove soil to a point just above the interval to be sampled. A decontaminated sampling tool will be used to collect the sample when the desired sampling depth has been reached. Soil for semivolatile organic and inorganic analyses is placed in the bowl and mixed; soil for volatile organic analysis is not mixed or composited but is placed directly into the appropriate sample bottles. A stainless-steel or dedicated wooden tongue depressor is used to transfer the sample from the bowl to the container.

The soils removed from the borehole should be visually described in the field log book, including approximated depths.

When sampling is completed, photo-ionization device (PID) readings should be taken directly above the hole, and the hole is then backfilled.

More details are provided in the SOP *Shallow Soil Sampling*.

B. Split-Spoon Sampling

Using a drilling rig, a hole is advanced to the desired depth. For split-spoon sampling, the samples are then collected following the ASTM D 1586 standard (attached). The sampler is lowered into the hole and driven to a depth equal to the total length of the sampler; typically this is 24 inches. The sampler is driven in 6-inch increments using a 140-pound weight (“hammer”) dropped from a height of 30 inches. The number of hammer blows for each 6-inch interval is counted and recorded. To obtain enough volume of sample for subsequent laboratory analysis, use of a 3-inch ID sampler may be required. Blow counts obtained with a 3-inch ID spoon would not conform to ASTM D 1586 and would therefore not be used for geotechnical evaluations.

Once retrieved from the hole, the sampler is carefully split open. Care should be taken not to allow material in the sampler to fall out of the open end of the sampler. To collect the sample, the surface of the sample should be removed with a clean tool and disposed of. Samples collected for volatiles analysis should be placed directly into the sample containers from the desired depth in the split spoon. Material for samples for all other parameters should be removed to a decontaminated stainless steel tray or disposable sealable bag. The sample for semivolatile organic and inorganic analyses should be homogenized in the field by breaking the sample into small pieces and removing gravel. The homogenized sample should be placed in the sample containers. If sample volume requirements are not met by a single sample collection, additional sample volume may be obtained by collecting a sample from below the sample and compositing the sample for non-volatile parameters only.

Split-spoon samples also will be collected using a tripod rig. When using a tripod rig the soil samples are collected using an assembly similar to that used by the drilling rig.

C. Thin-Walled Tube Sampling

Undisturbed fine grained samples may be collected for analysis for geotechnical parameters such as vertical hydraulic conductivity. These samples will be collected using thin-walled sampling tubes (sometimes called Shelby tubes) according to ASTM D 1587 (attached). Tubes will be 24- to 36 inches long and 3- to 4-inches in diameter, depending upon the quantity of sample required. Undisturbed samples will be obtained by smoothly pressing the sampling tube through the interval to be sampled using the weight of the drilling rig. Jerking the sample should be avoided. Once the sample is brought to the surface, the ends will be sealed with bees wax and then sealed with end caps and heavy tape. The sample designation, data and time of sampling, and the up direction will be noted on the sampling tube. The tube shall be kept upright as much as possible and will be protected from freezing, which could disrupt the undisturbed nature of the sample. Samples for geochemical analysis normally are not collected from thin-walled tube samples.

IV. Attachments

ASTM D 1586 Standard Penetration Test Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586.pdf)

ASTM D 1587 Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587.pdf)

V. Key Checks and Preventative Maintenance

- Check that decontamination of equipment is thorough.
- Check that sample collection is swift to avoid loss of volatile organics during sampling.

Surface Water Sampling

I. Purpose and Scope

This procedure presents the techniques used in collecting surface water samples. Materials, equipment, and procedures may vary; refer to the Field Sampling Plan and operators manuals for specific details.

II. Materials and Equipment

Materials and equipment vary depending on type of sampling; the Field Sampling Plan should be consulted for project-specific details. Typical equipment required includes:

- Open tube sampler
- Dip sampler
- Weighted bottle sampler
- Hand pump
- Kemmerer or Van Dorn sampler
- Depth-integrating sampler
- Peristaltic pump
- Sample containers
- Meters for specific conductance, temperature, pH, and dissolved oxygen

III. Procedures and Guidelines

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in *SOP Decontamination of Personnel and Equipment*. Surface water samples collected from water bodies tidally influenced should be collected at low tide and under low flow conditions to minimize the dilution of potential contaminants. Methods for surface water sample collection are described below.

A. Manual Sampling

Surface water samples are collected manually by submerging a clean glass, stainless steel, or Teflon container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline. The most common sampler types are beakers, sealable bottles and jars, pond samplers, peristaltic pumps, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the

sampler assembly. Specific types of weighted bottle samplers include Kemmerer or Van Dorn and are acceptable in most instances.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle. If using a Peristaltic pump, lower the tubing into the water to the desired depth.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.
5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

IV. Attachments

None.

V. Key Checks and Items

- Start downstream, work upstream
- Log exact locations using permanent features
- Beware of hidden hazards

Locating and Clearing Underground Utilities

I. Purpose

The purpose of this SOP is to provide general guidelines and specific procedures that must be followed on Navy CLEAN projects for locating underground utilities and clearing dig locations in order to maximize our ability to avoid hitting underground utilities and to minimize liabilities to CH2M HILL and its subcontractors and health and safety risks to our project staff.

This SOP shall be used by Activity Managers and Project Managers to, in-turn, develop Activity-specific and project-specific utility location procedures. The activity and project-specific procedures will become part of work plans and project instructions and will be used to prepare scopes of work (SOWs) for the procurement of utility location subcontractors to meet the needs of individual projects.

This SOP also identifies the types of utility locating services that are available from subcontractors and the various tools that are used to locate utilities, and discusses when each type of service and tool may or may not be applicable.

II. Scope

Depending on the Navy/Marine Activity we typically find ourselves in one of two scenarios:

Scenario 1

The Activity provides utility locating (or dig clearance) services through the public works department or similar organization, or has a contract with an outside utility clearance service. Some of these services are provided in the form of dig permits which are required before you can dig or drill. In other cases no official permit is required and the process is somewhat vague.

Scenario 2

The Activity does not get involved in any utility locating processes aside from possibly providing the most recent utility maps, and relies on CH2M HILL to clear the dig locations.

Table 1 provides an up to date summary of which scenarios apply to the various primary Activities served under the Navy CLEAN program.

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided

by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

Therefore, regardless of what services the Navy provides, in most cases we still need to supplement this effort with clearance services from our own third party utility location subcontractor following the procedures and guideline outlined in Section IV of this SOP. The cost implications of providing this service will range from \$500 to several \$1,000 depending on the size of the project.

The scope of services that we ask our subcontractors to provide can involve utility marking/mapping or the clearing of individual dig locations. In the former we ask our subs to mark all utilities within a "site" and often ask them to prepare a map based on their work. In the later, we ask them to clear (identify if there are any utilities within) a certain radius of a proposed dig/drill location.

The appropriate requested scope of services for a project will depend on the project. Clearing individual boreholes is often less expensive and allows the sub to concentrate their efforts on a limited area. However if the scope of the investigation is fluid (all borehole locations are not predetermined) it may be best to mark and map an entire site or keep the subcontractor on call.

Clearance of individual dig locations should be done to a minimum 20 foot radius around the location.

An example SOW for a utility subcontractor procurement is provided in Attachment A.

III. Services and Equipment

This section provides a general description of the services available to help us locate subsurface utilities and describes the types of equipment that these services may (or may not) use to perform their work. It identifies the capabilities of each type of equipment to help the PM specify what they should require from our utility location subs.

Services

The services that are available to us for identifying and marking underground utilities are:

- The local public/private utility-run service such as Miss Utility
- Utility location subcontractors (hired by us)

Attachment B provides a detailed description of each type of organization. It also provides contact numbers and web sites for the various Miss-Utility-type organizations in the areas where we do work for the Navy and contacts and services provided by several subcontractors that we have used or spoken to in the past.

Equipment

Attachment C provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the PM determine if the equipment being used by a subcontractor is adequate.

It is important to make the potential subcontractors aware of the possible types of utilities (and utility materials) that are at the site, and to have them explain in their bid what types of equipment they will use to locate utilities / clear dig locations, and what the limitations of these equipment are.

A list of in-house experts that can be used to help you evaluate bids or answer questions you may have is provided in **Appendix C**.

IV. Procedures and Guidelines

This section presents specific procedures to be followed for the utility location work to be conducted by CH2M HILL and our subcontractors. In addition, a PM will have to follow the procedures required by the Activity to obtain their approvals, clearances and dig permits where necessary. These “dig permit” requirements vary by Activity and must be added to the project-specific SOP, or project instructions. It is preferable that the Activity perform their clearance processes before we follow up with our clearance work.

Activity Notification and Dig Permit Procedures

Identify Activity-specific permit and/or procedural requirements for excavation and drilling activities. Contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted by CH2M HILL as a follow-up to the services provided by the Navy. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor (subcontracted to CH2M HILL) to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include (these are further described in Attachment C):

- **Ground Penetrating Radar (GPR)**, which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF)**, involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be

detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.
- **Electronic markers**, are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- Contact utility companies or the state/regional utility protection service (such as Miss Utility) at least two (2) working days prior to intrusive activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation: this is a law. These services will only mark the location of public-utility-owned lines and not Navy-owned utilities. In many cases there will not be any public-utility-owned lines on the Activity. There may also be Base-access issues to overcome.
- Procure and schedule the independent survey.
- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project site, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions. *The types of utilities must be provided to the bidding subcontractors in the SOW and procedures to be used must be specified by the bidder in their bid. It is extremely helpful to provide the sub with utility maps, with the caveat that all utilities are not necessarily depicted.*
- The survey subcontractor shall employ the same geophysical techniques used to identify the buried utilities, to survey the proposed path of subsurface investigation/construction work to confirm no buried utilities are present.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances provided by both the "Miss Utility" service and the CH2M HILL-subcontracted service are to be in writing, signed by the party conducting the clearance. The Miss Utility service will have standard notification forms/letters which typically simply state that they have been to the site and have done their work. The CH2M HILL subcontractor shall be required to fill out the form provided in Attachment D (this can be modified for a particular project) indicating that each dig/drill location has been addressed. *This documentation requirement (with a copy of the form) needs to be provided in the subcontractor SOW.*

- Marking shall be done using the color coding presented in Attachment E. The type of material used for marking must be approved by the Activity prior to marking. Some base commanders have particular issues with persistent spray paint on their sidewalks and streets. *Any particular marking requirements need to be provided in the subcontractor SOW.*
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Perform a field check prior to drilling/digging (preferably while the utility location sub is still at the site) to see if field utility markings coincide with locations on utility maps. Look for fire hydrants, valves, manholes, light poles, lighted signs, etc to see if they coincide with utilities identified by the subcontractor.
- Underground utility locations must be physically verified (or dig locations must be physically cleared) by hand digging using wood or fiberglass-handled tools, air knifing, or by some other acceptable means approved by CH2M HILL, when the dig location (e.g. mechanical drilling, excavating) is expected to be within 5 feet of a marked underground system. Hand clearance shall be done to a depth of four feet unless a utility cross-section is available that indicates the utility is at a greater depth. In that event, the hand clearance shall proceed until the documented depth of the utility is reached.
- Conduct a site briefing for employees at the start of the intrusive work regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

IV. Attachments

- A- Example SOW for Utility Location Subcontractor Procurement
- B - Services Available for Identifying and Marking Underground Utilities
- C – Equipment Used for Identifying Underground Utilities
- D – Utility Clearance Documentation Form
- E – Utility Marking Color Codes

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

A licensed and insured utility locator will be subcontracted to identify and mark out subsurface utilities for an environmental investigation/remediation project at Site XX of <<insert name of base, city, and state>>. The subcontractor will need to be available beginning at <<insert time>> on <<insert date>>. It is estimated that the work can be completed within XX days.

Proposed Scope of Work

The subcontractor will identify and mark all subsurface utilities (CHOOSE 1) that lie within a radius of 20 feet of each of XX sampling locations at Site XX shown on the attached Figure 1; (OR) that lie within the bounds of Site XX as delineated on the attached Figure 1. (If multiple sites are to be cleared, provide maps of each site with sample locations or clearance boundaries clearly delineated and a scale provided.)

Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of drilling and sampling personnel and the protection of the base infrastructure. The location of utilities identified from as-built drawings or other maps must be verified in the field prior to marking.

Base utility drawings for the Site(s) (CHOOSE 1) can be found at <<insert specific department and address or phone number on the base>> and should be reviewed by the subcontractor and referenced as part of the utility locating. (OR), will be provided to the subcontractor by CH2M HILL upon the award of the subcontract. (OR), are not available. Utility drawings shall not be considered definitive and must be field verified.

Field verification will include detection using nonintrusive subsurface detection equipment (magnetometers, GPR, etc) as well as opening manhole covers to verify pipe directions. As part of the bid, the Subcontractor shall provide a list of the various subsurface investigation tools they propose to have available and use at the site and what the limitations are of each tool.

A CH2M HILL representative shall be present to coordinate utility clearance activities and identify points and features to be cleared.

Field Marking and Documentation

All utilities located within **(CHOOSE 1) a 20-ft radius of the XX proposed soil boring locations (OR) within the boundary of the site(s)** as identified on the attached figure(s) will be marked using **paint (some Bases such as the WNY may have restrictions on the use of permanent paint)** and/or pin flags color coded to indicate electricity, gas, water, steam, telephone, TV cable, fiber optic, sewer, etc. The color coding shall match the industry standard as described on the attached form. In addition, the **Buried Utility Location Tracking Form** (attached) will be completed by the Subcontractor based upon what is identified in the field during the utility locating and submitted back to CH2M HILL (field staff or project manager) within 24 hours of completing the utility locating activities.

(OPTIONAL) The subcontractor shall also provide a map (or hand sketch) of the identified utilities to the Engineer within XX days of field demobilization. The map shall include coordinates or ties from fixed surface features to each identified subsurface utility.

Bid Sheet/Payment Units

The subcontractor will bid on a time and materials basis for time spent on site and researching utility maps. Mobilization (including daily travel to the site) should be bid as a lump sum, as well as the preparation of the AHA **and any required mapping**. The per diem line item should be used if the field crew will require overnight accommodations at the project site.

Health and Safety Requirements

The utility locating subcontractor is to provide and assume responsibility for an adequate corporate Health and Safety Plan for onsite personnel. Standard personal safety equipment including: hard hat, safety glasses, steel-toed boots, gloves are recommended for all project activities. Specific health and safety requirements will be established by the Subcontractor for each project. The health and safety requirements will be subject to the review of CH2M HILL.

The subcontractor shall also prepare and provide to the Engineer, at least 48 hours prior to mobilization, an acceptable Activity Hazard Analysis (AHA) using the attached AHA form or similar.

It is also required that all subcontractor personnel who will be on site attend the daily 15-minute health and safety tailgate meeting at the start of each day in the field.

Subcontractor personnel showing indications of being under the influence of alcohol or illegal drugs will be sent off the job site and their employers will be notified. Subcontractor personnel under the influence of prescription or over-the-counter medication that may impair their ability to operate equipment will not be permitted to do so. It is expected that the subcontractor will assign them other work and provide a capable replacement (if necessary) to operate the equipment to continue work.

Security

The work will be performed on US Navy property. CH2M HILL will identify the Subcontractor personnel who will perform the work to the appropriate Navy facility point-of-contact, and will identify the Navy point-of-contact to the Subcontractor crew. The Subcontractor bears final responsibility for coordinating access of his personnel onto Navy property to perform required work. This responsibility includes arranging logistics and providing to CH2M HILL, in advance or at time of entry as specified, any required identification information for the Subcontractor personnel. Specifically, the following information should be submitted with the bid package for all personnel that will perform the work in question (this information is required to obtain a base pass):

- Name
- Birth Place
- Birth Date
- Social Security Number
- Drivers License State and Number
- Citizenship

Please be advised that no weapons, alcohol, or drugs will be permitted on the Navy facility at any time. If any such items are found, they will be confiscated, and the Subcontractor will be dismissed.

Quality Assurance

The Subcontractor will be licensed and insured to operate in the State of <<state>> and will comply with all applicable federal, state, county and local laws and regulations. The subcontractor will maintain, calibrate, and operate all electronic locating instruments in accordance with the manufacturer's recommendations. Additionally, the Subcontractor shall make all reasonable efforts to review as-built engineering drawings maintained by Base personnel, and shall notify the CH2M HILL Project Manager in writing (email is acceptable) whenever such documentation was not available or could not be reviewed.

Subcontractor Standby Time

At certain periods during the utility locating activities, the Subcontractor's personnel may be asked to stop work and standby when work may normally occur. During such times, the Subcontractor will cease activities until directed by the CH2M HILL representative to resume operations. Subcontractor standby time also will include potential delays caused by the CH2M HILL representative not arriving at the site by the agreed-upon meeting time for start of the work day. Standby will be paid to the

Subcontractor at the hourly rate specified in the Subcontractor's Bid Form attached to these specifications.

Cumulative Subcontractor standby will be accrued in increments no shorter than 15 minutes (i.e., an individual standby episode of less than 15 minutes is not chargeable).

During periods for which standby time is paid, the surveying equipment will not be demobilized and the team will remain at the site. At the conclusion of each day, the daily logs for the Subcontractor and CH2M HILL representative will indicate the amount of standby time incurred by the Subcontractor, if any. Payment will be made only for standby time recorded on CH2M HILL's daily logs.

Down Time

Should equipment furnished by the Subcontractor malfunction, preventing the effective and efficient prosecution of the work, or inclement weather conditions prevent safe and effective work from occurring, down time will be indicated in the Subcontractor's and CH2M Hill representative's daily logs. No payment will be made for down time.

Schedule

It is anticipated that the subsurface utility locating activities will occur on <<insert date>>. It is estimated that the above scope will be completed within XXX days.

Attachment B - Services Available for Identifying and Marking Underground Utilities

The services that are available to us for identifying and marking underground utilities are:

- The Activity's PWC (or similar organization)
- The local public/private utility -run service such as Miss Utility
- Utility location subcontractors (hired by CH2M HILL)

Each are discussed below.

Navy Public Works Department

A Public Works Department (PWD) is usually present at each Activity. The PWD is responsible for maintaining the public works at the base including management of utilities. In many cases, the PWD has a written permit process in place to identify and mark-out the locations of Navy-owned utilities [Note: The PWD is usually NOT responsible for the locations/mark-outs of non-Navy owned, public utilities (e.g., Washington Gas, Virginia Power, municipal water and sewer, etc.). Therefore, it is likely that we will have to contact other organizations besides the PWD in order to identify non-Navy owned, public utilities].

At some Activities, there may not be a PWD, the PWD may not have a written permit process in place, or the PWD may not take responsibility for utility locating and mark-outs. In these cases, the PWD should still be contacted since it is likely that they will have the best understanding of the utility locations at the Activity (i.e., engineering drawings, institutional knowledge, etc.). Subsequently, the PWD should be brought into a cooperative arrangement (if possible) with the other services employed in utility locating and mark-out in order to have the most comprehensive assessment performed.

At all Activities we should have a contact (name and phone number), and preferably an established relationship, with PWD, either directly or through the NAVFAC Atlantic, Midlant, or Washington NTR or Activity Environmental Office that we can work with and contact in the event of problems.

Miss Utility or "One Call" Services for Public Utility Mark-outs

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss

Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

For the Mid-Atlantic region, the following "One Call" service centers are available.

Name	Phone	Website	Comments
Miss Utility of DELMARVA	800-257-7777	www.missutility.net	Public utility mark-outs in Delaware, Maryland, Washington, DC, and Northern Virginia
Miss Utility of Southern Virginia (One Call)	800-552-7001	not available	Public utility mark-outs in Southern Virginia
Miss Utility of Virginia	800-257-7777 800-552-7007	www.missutilityofvirginia.com	General information on public utility mark-outs in Virginia, with links to Miss Utility of DELMARVA and Miss Utility of Southern Virginia (One Call)
Miss Utility of West Virginia, Inc	800-245-4848	none	Call to determine what utilities they work with in West Virginia
North Carolina One Call Center	800-632-4949	www.ncocc.org/ncocc/default.htm	Public Utility Markouts in North Carolina

Private Subcontractors

- Utility-locating support is required at some level for most all CH2M HILL field projects in "clearing" proposed subsurface boring locations on the project site. Utility location and sample clearance can include a comprehensive effort of GIS map interpretation, professional land surveying, field locating, and geophysical surveying. Since we can usually provide our own GIS-related services for projects and our professional land surveying services are normally procured separately, utility-locating subcontractors will normally only be required for some level of geophysical surveying support in the field. This level of geophysical surveying support can range widely from a simple electromagnetic (EM) survey over a known utility line, to a blind geophysical effort, including a ground-penetrating radar (GPR) survey and/or a comprehensive EM survey to delineate and characterize all unknown subsurface anomalies.

The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and recent construction is limited, CH2M HILL may be confident with a limited effort from a traditional utility-locating subcontractor providing a simple EM survey. At

sites where utility locations are not well defined, where recent constructions may have altered utility locations, or the nature of the site makes utility location difficult, CH2M HILL will require the services of a comprehensive geophysical surveying subcontractor, with a wide range of GPR and EM services available for use on an "as-needed" basis. Typical costs for geophysical surveying subcontractors will range from approximately \$200 per day for a simple EM effort (usually one crew member and one instrument) to approximately \$1,500 per day for a comprehensive geophysical surveying effort (usually a two-person crew and multiple instruments). Comprehensive geophysical surveying efforts may also include field data interpretation (and subsequent report preparation) and non-destructive excavation to field-verify utility depths and locations.

The following table provides a list of recommended geophysical surveying support subcontractors that can be used for utility-locating services:

Company Name and Address	Contact Name and Phone Number	Equipment ¹					Other Services ²		
		1	2	3	4	5	A	B	C
US Radar, Inc.* PO Box 319 Matawan, NJ 07747	Ron LaBarca 732-566-2035			4					
Utilities Search, Inc.*	Jim Davis 703-369-5758	4				4	4	4	4
So Deep, Inc.* 8397 Euclid Avenue Manassas Park, VA 20111	703-361-6005	4					4	4	4
Accurate Locating, Inc. 1327 Ashton Rd., Suite 101 Hanover, MD 21076	Ken Shipley 410-850-0280	4	4						
NAEVA Geophysics, Inc. P.O. Box 7325 Charlottesville, VA 22906	Alan Mazurowski 434-978-3187	4	4	4	4	4	4	4	4
Earth Resources Technology, Inc. 8106 Stayton Rd. Jessup, MD 20794	Peter Li 240-554-0161	4	4	4	4	4	4	4	
Geophex, Ltd 605 Mercury Street Raleigh, NC 27603	I. J. Won 919-839-8515	4	4	4	4	4	4	4	4

Notes:

*Companies denoted with an asterisk have demonstrated reluctance to assume responsibility for damage to underground utilities or an inability to accommodate the insurance requirements that CH2M HILL requests for this type of work at many Navy sites.

¹Equipment types are:

1. Simple electromagnetic instruments, usually hand-held
2. Other, more innovative, electromagnetic instruments, including larger instruments for more area coverage
3. Ground-penetrating radar systems of all kinds
4. Audio-frequency detectors of all kinds
5. Radio-frequency detectors of all kinds

²Other services include:

- A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.
- B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.
- C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

This attachment provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the AM and PM determine if the equipment being proposed by a subcontractor or Navy is adequate. A list of in-house experts that can be used to answer questions you may have is provided below.

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

EMI instruments, in general, induce an electromagnetic field into the ground (the primary field) and then record the response (the secondary field), if any. Lateral changes in subsurface conductivity, such as caused by the presence of buried metal or by significant soil variations, cause changes in the secondary field recorded by the instrument and thus enable detection and mapping of the subsurface features. It should be noted that EMI only works for electrically conductive materials--plastic or PVC pipes are generally not detected with EMI. Water and gas lines are commonly plastic, although most new lines include a copper “locator” strip on the top of the PVC to allow for detection with EMI.

EMI technology encompasses a wide range of instruments, each with inherent strengths and weaknesses for particular applications. One major division of EMI is between “time-domain” and “frequency-domain” instruments that differ in the aspect of the secondary field they detect. Another difference in EMI instruments is the operating frequency they use to transmit the primary field. Audio- and radio-frequencies are often used for utility detection, although other frequencies are also used. Consideration of the type of utility expected, surface features that could interfere with detection, and the “congestion” of utilities in an area, should be made when choosing a particular EMI instrument for a particular site.

One common EMI tool used for utility location is a handheld unit that can be used to quickly scan an area for utilities and allows for marking locations in “real time”. This method is most commonly used by “dig-safe” contractors marking out known utilities prior to excavation. It should be noted that this method works best when a signal (the primary field) can be placed directly onto the line (i.e., by clamping or otherwise connecting to the end of the line visible at the surface, or for larger utilities such as sewers, by running a transmitter through the utility). These types of tools also have a limited capability to scan an area for unknown utilities. Usually this requires having enough area to separate a hand held transmitter at least a hundred feet from the

receiver. Whether hunting for unknown, or confirming known, utilities, this method will only detect continuous lengths of metallic conductors.

In addition to the handheld EMI units, larger, more powerful EMI tools are available that provide more comprehensive detection and mapping of subsurface features. Generally, data with these methods are collected on a regular grid in the investigation area, and are then analyzed to locate linear anomalies that can be interpreted as utilities. These methods will usually detect *all* subsurface metal (above a minimum size), including pieces of abandoned utilities. In addition, in some situations, backfill can be detected against native soils giving information on trenching and possible utility location. Drawbacks to these methods are that the secondary signals from utilities are often swamped (i.e., undetectable) close to buildings and other cultural features, and that the subsurface at heavily built-up sites may be too complicated to confidently interpret completely.

Hand-held metal detectors (treasure-finders) are usually based on EMI technology. They can be used to locate shallow buried metal associated with utilities (e.g., junctions, manholes, metallic locators). Advantages of these tools is the ease of use and real-time marking of anomalies. Drawbacks include limited depths of investigations and no data storage capacity.

Ground Penetrating Radar (GPR)

GPR systems transmit radio and microwave frequency (e.g., 80 megaHertz to 1,000 megaHertz) waves into the ground and then record reflections of those waves coming back to the surface. Reflections of the radar waves typically occur at lithologic changes, subsurface discontinuities, and subsurface structures. Plastic and PVC pipes can sometimes be detected in GPR data, especially if they are shallow, large, and full of a contrasting material such as air in a wet soil, or water in a dry soil. GPR data are usually collected in regular patterns over an area and then analyzed for linear anomalies that can be interpreted as utilities. GPR is usually very accurate in x-y location of utilities, and can be calibrated at a site to give very accurate depth information as well. A significant drawback to GPR is that depth of investigation is highly dependant on background soil conductivity, and it will not work on all sites. It is not uncommon to get only 1-2 feet of penetration with the signal in damp, clayey environments. Another drawback to GPR is that sites containing significant fill material (e.g., concrete rubble, scrap metal, garbage) will result in complicated anomalies that are difficult or impossible to interpret.

Magnetic Field Methods

Magnetic field methods rely on detecting changes to the earth's magnetic field caused by ferrous metal objects. This method is usually more sensitive to magnetic metal (i.e., deeper detection) than EMI methods. A drawback to this method is it is more susceptible to being swamped by surface features such as fences and cars. In addition, procedures must usually be implemented that account for natural variations in the earth's background field as it changes throughout the day. One common use of the method is to measure and analyze the gradient of the magnetic field, which eliminates most of the drawbacks to the method. It should be noted this method only detects

ferrous metal, primarily iron and steel for utility location applications. Some utility detector combine magnetic and EMI methods into a single hand-held unit.

Optical Methods

Down the hole cameras may be useful in visually reviewing a pipe for empty conduits and/or vaults.

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

The following is the standard color code used by industry to mark various types of utilities and other features at a construction site.

White – Proposed excavations and borings

Pink – Temporary survey markings

Red – Electrical power lines, cables, conduits and lighting cables

Yellow – Gas, oil, steam, petroleum or gaseous materials

Orange – Communication, alarm or signal lines, cables, or conduits

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

Water-Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in piezometers and monitoring wells, even where a second phase of floating liquid (e.g., gasoline) is encountered, and on staff gages in surface-water bodies. This SOP includes guidelines for discrete measurements of static water levels and does not cover the use of continuously recording loggers (see SOP *Use of Data Loggers and Pressure Transducers*).

II. Equipment and Materials

- Electronic water-level meter (Solinst® or equivalent) with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less
- Interface probe (Solinst® Model 122 Interface Meter or equivalent)

III. Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically this is the top of the PVC casing. If no reference is clearly visible, measure the depth to water from the northern edge of the PVC casing. If access to the top of the PVC casing is difficult, sight across the top of the locking casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface.

Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also when specified in the project plans, measure and record the depth of the piezometer or well. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

Free product light or dense nonaqueous phase liquid may be present in the piezometer or well. If the presence of free product is suspected, the thickness of the product should be determined using appropriate equipment (e.g., Solinst® Model 122 Interface Meter). The depth to water also is determined with this equipment and the water-level meter should not be used in the piezometer or well as long as product is present. Typically, a constant sound is emitted from the device when free product is encountered and an alternating on/off beep sound is emitted when water is encountered.

The apparent elevation of the water level in the well or piezometer is determined by measuring both the apparent depth to water and the thickness of free product. The corrected water-level elevation is calculated by the following equation:

$$WL_c = WL_a + (\text{Free-product thickness} \times 0.80)$$

Where WL_c = Corrected water-level elevation

WL_a = Apparent water-level elevation

0.80 = Typical value for the density of petroleum hydrocarbon products.

If free product is detected on the surface of the water in the piezometer or well, the value of sampling should be reconsidered because of the potential for contaminating the sampling equipment.

Staff gages may be installed in some surface-water bodies. These facilities typically are constructed by attaching a calibrated, marked staff gage to a wood or metal post, driving the post into the bottom of the surface-water body, and surveying the elevation of the top of the post to a resolution of 0.01-foot. The elevation of the water in the surface-water body then can be determined by reading off the distance the water level is from the top of the post. A shield or other protection may be needed to calm the fluctuations in water level if the gage is installed at a location exposed to wind or wave.

IV. Attachments

None.

V. Key Checks

- Before each use, verify that the battery is charged by pressing the test button on the water-level meter.
- Verify that the unit is operating correctly by testing the probe in distilled or de-ionized water. Leave the unit turned off when not in use.

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a Horiba or YSI Water Quality Parameter Meter with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using a water quality parameter meter (e.g., Horiba® or YSI) for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of aqueous samples. The YSI instrument does not measure turbidity. A separate turbidity meter (i.e., Hanna Turbidity Meter) will need to be used in conjunction with the YSI meter. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Water Quality Parameter Meter such as a Horiba® Water Quality Monitoring System or YSI with flow-through cell
- Auto-Calibration Standard Solution (provided by rental company)
- Distilled water in squirt bottle

III. Procedures and Guidelines

A. Parameters and Specifications:

<u>Parameter</u>	<u>Range of measurement</u>	<u>Accuracy</u>
pH	0 to 14 pH units	+/- 0.1 pH units
Specific conductance	0 to 9.99 S/m	+/- 3 % full scale
Turbidity	0 to 800 NTU	+/- 5 % full scale
Dissolved oxygen	0 to 19.99 mg/l	+/- 0.2 mg/l
Temperature	0 to 55 °C	+/- 1.0 °C
ORP	-999 to +999 mV	+/- 15 mV
Salinity	0 to 4 %	+/- 0.3 %

B. Calibration:

Prior to each day's use, clean the probe and flow-through cell using deionized water and calibrate using the Standard Solution.

Horiba Calibration procedure:

1. Fill a calibration beaker with standard solution to the recommended fill line.
2. Insert the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.
3. Turn power on and allow some time for the machine to warm-up prior to starting the calibration. When the initial readings appear to stabilize the instrument is ready to calibrate.
4. Press CAL key to put the unit in the calibration mode.
5. Press the ENT key to start automatic calibration. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.
6. If the unit is calibrated properly the instrument readings, while immersed in the standard solution, will match the standard solution values provided on the solution container. The typical standard solution values are: pH = 4.0 +/- 3%, conductivity 4.49 mS/cm +/- 3%, and turbidity = 0 NTU +/- 3%.
7. Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

YSI Calibration procedure:

1. Press the **On/off** key to display the run screen
2. Press the **Escape** key to display the main menu screen
3. Use the arrow keys to highlight the **Calibrate**
4. Press the **Enter** key. The Calibrate screen is displayed
5. Choose the parameter to calibrate

A. *Conductivity Calibration:*

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

- 1) Use the arrow keys to highlight the **Conductivity** selection
- 2) Press **Enter**. The Conductivity Calibration Selection Screen is displayed.
- 3) Use the arrow keys to highlight the Specific Conductance selection.
- 4) Press **Enter**. The Conductivity Calibration Entry Screen is displayed.

- 5) Place the correct amount of conductivity standard (see Instrument Manual) into a clean, dry or pre-rinsed transport/calibration cup.
- 6) Carefully immerse the sensor end of the probe module into the solution.
- 7) Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from the Instrument Manual Calibration Volumes should ensure that the vent hole is covered.
- 8) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
NOTE: Do not over tighten as this could cause damage to the threaded portions.
- 9) Use the keypad to enter the calibration value of the standard you are using.
NOTE: Be sure to enter the value in **mS/cm at 25°C**.
- 10) Press **Enter**. The Conductivity Calibration Screen is displayed.
- 11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
- 12) Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 13) Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen
- 14) Press **Escape** to return to the calibrate menu.
- 15) Rinse the probe module and sensors in tap or purified water and dry.

B. Dissolved Oxygen Calibration:

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

- 1) Go to the calibrate screen as described in Section
NOTE: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.
- 2) Use the arrow keys to highlight the **Dissolved Oxygen** selection.
- 3) Press **Enter**. The dissolved oxygen calibration screen is displayed.
- 4) DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).
- 5) Use the arrow keys to highlight the **DO mg/L** selection.
- 6) Press **Enter**. The DO mg/L Entry Screen is displayed.
- 7) Place the probe module in water with a known DO concentration.
NOTE: Be sure to completely immerse all the sensors.
- 8) Use the keypad to enter the known DO concentration of the water.
- 9) Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.
- 10) Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
- 11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

- 12) Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 13) Press **Enter**. This returns you to the DO calibration screen.
- 14) Press **Escape** to return to the calibrate menu.
- 15) Rinse the probe module and sensors in tap or purified water and dry.

C. *pH Calibration:*

- 1) Go to the calibrate screen.
- 2) Use the arrow keys to highlight the **pH** selection.
- 3) Press **Enter**. The pH calibration screen is displayed.
 - Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
 - Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
 - Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.
- 4) Use the arrow keys to highlight the **2-point** selection.
- 5) Press **Enter**. The pH Entry Screen is displayed.
- 6) Place the correct amount of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.
- 7) Carefully immerse the sensor end of the probe module into the solution.
- 8) Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.
- 9) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not over tighten as this could cause damage to the threaded portions.

- 10) Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

- 11) Press **Enter**. The pH calibration screen is displayed.
- 12) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
- 13) Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 14) Press **Enter**. This returns you to the Specified pH Calibration Screen.
- 15) Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.
- 16) Repeat steps 6 through 13 above using a second pH buffer.
- 17) Press **Enter**. This returns you to the pH Calibration Screen.
- 18) Press **Escape** to return to the calibrate menu.
- 19) Rinse the probe module and sensors in tap or purified water and dry.

D. ORP Calibration:

- 1) Go to the calibrate screen.
- 2) Use the arrow keys to highlight the **ORP** selection.
- 3) Press **Enter**. The ORP calibration screen is displayed.
- 4) Place the correct amount of a known ORP solution into a clean, dry or pre-rinsed transport/calibration cup.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.

- 5) Carefully immerse the sensor end of the probe module into the solution.
- 6) Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

NOTE: The sensor must be completely immersed.

- 7) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
- 8) Use the keypad to enter the correct value of the calibration solution you are using at the current temperature.
- 9) Press **Enter**. The ORP calibration screen is displayed.
- 10) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
- 11) Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 12) Press **Enter**. This returns you to the Calibrate Screen.
- 13) Rinse the probe module and sensors in tap or purified water and dry.

Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

C. Sample Measurement:

Horiba measurement procedure:

As water passes through the flow-through the flow cell, press MEAS to obtain reading; record data in a field notebook.

YSI measurement procedure:

As water passes through the flow-through the flow cell, the readings are displayed for each parameter. Record the water quality parameter data in a field notebook. In addition, the data is recorded in the YSI and can be downloaded to a computer following completion of the sampling event.

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance and troubleshooting
- Check batteries, and have a replacement set on hand
- Due to the importance of obtaining these parameters, the field team should have a spare unit readily available in case of an equipment malfunction.

V. References

YSI 556 Multi Probe System Operator Manual

Appendix B

Ecological Screening Values

Ecological Screening Values (ESVs) for Freshwater Sediment

Chemical	ESV	Units	Reference	Comments ¹
Metals				
Lead	35.8	mg/kg	MacDonald et al. 2000	TEC
Semivolatile Organic Compounds				
2-Methylnaphthalene	20.2	ug/kg	MacDonald 1994	TEL (marine)
Acenaphthene	290	ug/kg	Buchman 2008	UET
Acenaphthylene	160	ug/kg	Buchman 2008	UET
Anthracene	57.2	ug/kg	MacDonald et al. 2000	TEC
Benzo(a)anthracene	108	ug/kg	MacDonald et al. 2000	TEC
Benzo(a)pyrene	150	ug/kg	MacDonald et al. 2000	TEC
Benzo(b)fluoranthene	240	ug/kg	Benzo(k)fluoranthene value	
Benzo(g,h,i)perylene	170	ug/kg	Persaud et al. 1993	LEL
Benzo(k)fluoranthene	240	ug/kg	Persaud et al. 1993	LEL
Chrysene	166	ug/kg	MacDonald et al. 2000	TEC
Dibenz(a,h)anthracene	33.0	ug/kg	MacDonald et al. 2000	TEC
Fluoranthene	423	ug/kg	MacDonald et al. 2000	TEC
Fluorene	77.4	ug/kg	MacDonald et al. 2000	TEC
Indeno(1,2,3-cd)pyrene	200	ug/kg	Persaud et al. 1993	LEL
Naphthalene	176	ug/kg	MacDonald et al. 2000	TEC
PAH (HMW)	2,900	ug/kg	Jones et al. 1997	ARCS TEC
PAH (LMW)	786	ug/kg	Jones et al. 1997	ARCS TEC
PAH (total)	3,553	ug/kg	Jones et al. 1997	ARCS TEC
Phenanthrene	204	ug/kg	MacDonald et al. 2000	TEC
Pyrene	195	ug/kg	MacDonald et al. 2000	TEC
1 - LEL: Lowest Effect Level; TEC: Threshold Effect Concentration; TEL: Threshold Effect Level; UET: Upper Effects Threshold				

References:

Buchman, M.F. 2008. *NOAA screening quick reference tables*. NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration. 34 pp.

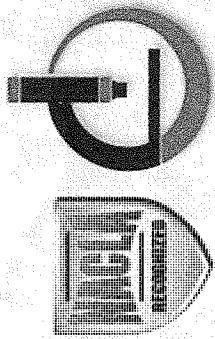
Jones, D.S., G.W. Suter II, and R.N. Hull. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota: 1997 revision. Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-95/R4.

MacDonald, D.D. 1994. Approach to the assessment of sediment quality in Florida coastal waters. Volume 1 – Development and evaluation of sediment quality assessment guidelines. Prepared for the Florida Department of Environmental Protection, Office of Water Policy. November.

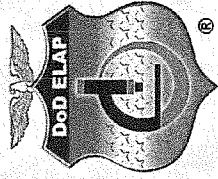
MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Archives of Environmental Contamination and Toxicology*. 39:20-31.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the protection and management of aquatic sediment quality in Ontario*. ISBN 0-7729-9248-7. 27 pp.

Appendix C
Laboratory Department of Defense
Environmental Laboratory Accreditation Letters



**LABORATORY
ACCREDITATION
BUREAU**



Certificate of Accreditation

ISO/IEC 17025:2005

Certificate Number L2223

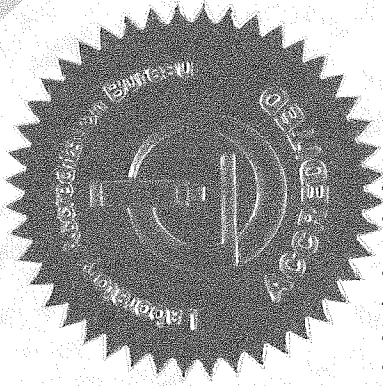
Katahdin Analytical Services, Inc.

600 Technology Way
Scarborough ME 04074

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: February 1, 2016



R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 1st of February 2013

*See the laboratory's Scope of Accreditation for details of accredited parameters

**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

Scope of Accreditation

For

Katahdin Analytical Services, Inc.

600 Technology Way
Scarborough, ME 04074
Leslie Dimond
207-874-2400

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Katahdin Analytical Services to perform the following tests:

Accreditation granted through: February 1, 2016

Testing - Environmental

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8081B	2, 4'-DDD
GC/ECD	EPA 8081B	2, 4'-DDE
GC/ECD	EPA 8081B	2, 4'-DDT
GC/ECD	EPA 608; EPA 8081B	4, 4'-DDD
GC/ECD	EPA 608; EPA 8081B	4, 4'-DDE
GC/ECD	EPA 608; EPA 8081B	4, 4'-DDT
GC/ECD	EPA 608; EPA 8081B	Aldrin
GC/ECD	EPA 608; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Alpha-Chlordane
GC/ECD	EPA 608; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Cis-Nonaclor
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608; EPA 8081B	delta-BHC
GC/ECD	EPA 608; EPA 8081B	Dieldrin
GC/ECD	EPA 608; EPA 8081B	Endosulfan I
GC/ECD	EPA 608; EPA 8081B	Endosulfan II

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 608; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608; EPA 8081B	Endrin
GC/ECD	EPA 608; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin Ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608; EPA 8081B	Heptachlor
GC/ECD	EPA 608; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Hexachlorobenzene
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Mirex
GC/ECD	EPA 8081B	Oxychlordane
GC/ECD	EPA 608; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8081B	trans-Nonachlor
GC/ECD	EPA 608; EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A MOD	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A MOD	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)
GC/ECD	EPA 8082A	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 180)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5', 6-Heptachlorobiphenyl (BZ 183)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5-Hexachlorobiphenyl (BZ 138)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 6, 6'-Heptachlorobiphenyl (BZ 184)

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8082A	2, 2', 3, 4', 5, 5', 6-Heptachlorobiphenyl (BZ 187)
GC/ECD	EPA 8082A	2, 2', 3, 4, 5'-Pentachlorobiphenyl (BZ 87)
GC/ECD	EPA 8082A	2, 2', 3, 5'-Tetrachlorobiphenyl (BZ 44)
GC/ECD	EPA 8082A	2, 2', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 153)
GC/ECD	EPA 8082A	2, 2', 4, 5, 5'-Pentachlorobiphenyl (BZ 101)
GC/ECD	EPA 8082A	2, 2', 4, 5-Tetrachlorobiphenyl (BZ 48)
GC/ECD	EPA 8082A	2, 2', 4, 5'-Tetrachlorobiphenyl (BZ 49)
GC/ECD	EPA 8082A	2, 2', 5, 5'-Tetrachlorobiphenyl (BZ 52)
GC/ECD	EPA 8082A	2, 2', 5-Trichlorobiphenyl (BZ 18)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5-Hexachlorobiphenyl (BZ 156)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5'-Hexachlorobiphenyl (BZ 157)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4'-Pentachlorobiphenyl (BZ 105)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 189)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 167)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 118)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5'-Pentachlorobiphenyl (BZ 123)
GC/ECD	EPA 8082A	2, 3', 4, 4'-Tetrachlorobiphenyl (BZ 66)
GC/ECD	EPA 8082A	2, 3, 4, 4', 5-Pentachlorobiphenyl (BZ 114)
GC/ECD	EPA 8082A	2, 4, 4'-Trichlorobiphenyl (BZ 28)
GC/ECD	EPA 8082A	2, 4'-Dichlorobiphenyl (BZ 8)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 169)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 126)
GC/ECD	EPA 8082A	3, 3', 4, 4'-Tetrachlorobiphenyl (BZ 77)
GC/ECD	EPA 8082A	3, 4, 4', 5-Tetrachlorobiphenyl (BZ 81)
GC/ECD	EPA 8082A	Decachlorobiphenyl (BZ 209)
GC/ECD	EPA 8151A	2, 4, 5-T
GC/ECD	EPA 8151A	2, 4-D
GC/ECD	EPA 8151A	2, 4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2, 4, 5-TP)
GC/FID	EPA 8015C/D MOD	Diesel range organics (DRO)
GC/FID	EPA 8015C/D MOD	Total Petroleum Hydrocarbon (TPH)
GC/FID	EPA 8015C/D MOD	Gasoline range organics (GRO)
GC/FID/PID	MA DEP VPH	Volatile Organic Hydrocarbons
GC/FID	MA DEP EPH	Extractable Petroleum Hydrocarbons
GC/FID	CT ETPH	Total Petroleum Hydrocarbons
GC/FID	TNRCC Method 1005	Total Petroleum Hydrocarbons
GC/FID	FL-PRO	Petroleum Range Organics
GC/ECD	EPA 8011; EPA 504	1, 2-Dibromoethane (EDB)
GC/ECD	EPA 8011; EPA 504	1, 2-Dibromo-3-chloropropane
GC/FID	RSK-175	Methane Ethane Ethene
GC/MS	EPA 8260B/C; EPA 524.2	1, 1, 1, 2-Tetrachloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1, 1-Trichloroethane
GC/MS	EPA 624; 8260B/C; EPA 524.2	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1, 2-Trichloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1-Dichloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1-Dichloroethene
GC/MS	EPA 8260B/C; EPA 524.2	1, 1-Dichloropropene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 3-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 4-Trimethylbenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 524.2	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C; EPA 524.2	1, 2-Dibromoethane (EDB)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichlorobenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichloropropane
GC/MS	EPA 8260B/C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 3, 5-Trimethylbenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 3-Dichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 3-Dichloropropane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 4-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 4-Dioxane
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C; EPA 524.2	2, 2-Dichloropropane
GC/MS	EPA 8260B/C; EPA 524.2	2-Butanone
GC/MS	EPA 624; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C; EPA 524.2	2-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 524.2	2-Hexanone
GC/MS	EPA 8260B/C; EPA 524.2	4-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 524.2	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C; EPA 524.2	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624; EPA 8260B/C	Acrolein
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Acrylonitrile
GC/MS	EPA 8260B/C; EPA 524.2	Allyl chloride
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Benzene
GC/MS	EPA 8260B/C	Benzyl chloride
GC/MS	EPA 8260B/C; EPA 524.2	Bromobenzene
GC/MS	EPA 8260B/C; EPA 524.2	Bromochloromethane

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Bromodichloromethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Bromoform
GC/MS	EPA 8260B/C; EPA 524.2	Carbon disulfide
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Carbon tetrachloride
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chlorobenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C; EPA 524.2	cis-1, 2-Dichloroethene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	cis-1, 3-Dichloropropene
GC/MS	EPA 8260B/C	Cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Dibromochloromethane
GC/MS	EPA 8260B/C; EPA 524.2	Dibromomethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Dichlorodifluoromethane
GC/MS	EPA 8260B/C; EPA 524.2	Diethyl ether
GC/MS	EPA 8260B/C	Di-isopropylether
GC/MS	EPA 8260B/C; EPA 524.2	Ethyl methacrylate
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Ethylbenzene
GC/MS	EPA 8260B/C	Ethyl-t-butylether
GC/MS	EPA 8260B/C; EPA 524.2	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Iodomethane
GC/MS	EPA 8260B/C	Isobutyl alcohol
GC/MS	EPA 8260B/C	Isopropyl alcohol
GC/MS	EPA 8260B/C; EPA 524.2	Isopropyl benzene
GC/MS	EPA 8260B/C; EPA 524.2	m p-xylenes
GC/MS	EPA 8260B/C	Methyl acetate

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 524.2	Methacrylonitrile
GC/MS	EPA 624 / 8260B,C	Methyl bromide (Bromomethane)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C; EPA 524.2	Methyl methacrylate
GC/MS	EPA 8260B/C; EPA 524.2	Methyl tert-butyl ether
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Methylene chloride
GC/MS	EPA 8260B/C; EPA 524.2	Naphthalene
GC/MS	EPA 8260B/C; EPA 524.2	n-Butylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	n-Propylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	o-Xylene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C; EPA 524.2	p-Isopropyltoluene
GC/MS	EPA 8260B/C; EPA 524.2	Propionitrile
GC/MS	EPA 8260B/C; EPA 524.2	sec-butylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	Styrene
GC/MS	EPA 8260B/C	t-Amylmethylether
GC/MS	EPA 8260B/C; EPA 524.2	tert-Butyl alcohol
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Tetrachloroethene (Perchloroethylene)
GC/MS	EPA 8260B/C; EPA 524.2	Tetrahydrofuran
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Toluene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	trans-1, 2-Dichloroethylene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	trans-1, 3-Dichloropropylene
GC/MS	EPA 8260B/C; EPA 524.2	trans-1, 4-Dichloro-2-butene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Vinyl chloride
GC/MS	EPA 624 / 8260B,C	Xylene
GC/MS	EPA 8260B/C SIM	1,1,1,2-Tetrachloroethane
GC/MS	8260B, C SIM	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethene
GC/MS	EPA 8260B/C SIM	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C SIM	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C SIM	1,2-Dibromoethane
GC/MS	EPA 8260B/C SIM	1,2-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,2-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,3-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	2-Hexanone
GC/MS	EPA 8260B/C SIM	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C SIM	Benzene
GC/MS	EPA 8260B/C SIM	Bromodichloromethane
GC/MS	EPA 8260B/C SIM	Carbon Tetrachloride
GC/MS	EPA 8260B/C SIM	Chloroform
GC/MS	EPA 8260B/C SIM	Chloromethane
GC/MS	EPA 8260B/C SIM	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Dibromochloromethane
GC/MS	EPA 8260B/C SIM	Ethylbenzene
GC/MS	EPA 8260B/C SIM	Isopropylbenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C SIM	Hexachlorobutadiene
GC/MS	EPA 8260B/C SIM	Methylcyclohexane
GC/MS	EPA 8260B/C SIM	m,p-Xylene
GC/MS	EPA 8260B/C SIM	o-Xylene
GC/MS	EPA 8260B/C SIM	Tetrachloroethene
GC/MS	EPA 8260B/C SIM	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	Trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Trichloroethene
GC/MS	EPA 8260B/C SIM	Trichlorofluoromethane
GC/MS	EPA 8260B/C SIM	Vinyl Chloride
GC/MS	EPA 8260B/C SIM	Xylenes (total)
GC/MS	EPA 8270C/D	1, 2, 4, 5-Tetrachlorobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 2, 4-Trichlorobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 2-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1, 3, 5-Trinitrobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 3-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 3-Dinitrobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 4-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 4-Dioxane
GC/MS	EPA 8270C/D	1, 4-Naphthoquinone
GC/MS	EPA 8270C/D	1, 4-Phenylenediamine
GC/MS	EPA 8270C/D	1-Chloronaphthalene
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	1-Naphthylamine
GC/MS	EPA 8270C/D	2, 3, 4, 6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2, 4, 5-Trochlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4, 6-Trichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dimethylphenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dinitrophenol

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dinitrotoluene (2, 4-DNT)
GC/MS	EPA 8270C/D	2, 6-Dichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 6-Dinitrotoluene (2, 6-DNT)
GC/MS	EPA 8270C/D	2-Acetylaminofluorene
GC/MS	EPA 625; EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 625; EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 625; EPA 8270C/D	2-Methyl-4 6-dinitrophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol
GC/MS	EPA 8270C/D	2-Naphthylamine
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 625; EPA 8270C/D	2-Nitrophenol
GC/MS	EPA 8270C/D	2-Picoline
GC/MS	EPA 8270C/D	3-Methylcholanthrene
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4-Aminobiphenyl
GC/MS	EPA 625; EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 625; EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 625; EPA 8270C/D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C/D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270C/D	3, 4-Methylphenol
GC/MS	EPA 8270C/D	4-Nitroaniline
GC/MS	EPA 625; EPA 8270C/D	4-Nitrophenol
GC/MS	EPA 8270C/D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	5-Nitro-o-toluidine
GC/MS	EPA 8270C/D	7, 12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	a a-Dimethylphenethylamine
GC/MS	EPA 625; EPA 8270C/D	Acenaphthene
GC/MS	EPA 625; EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetophenone

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 625; EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Aramite
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Azobenzene
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 625; EPA 8270C/D	Benzidine
GC/MS	EPA 625; EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 625; EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 625; EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 625; EPA 8270C/D	Benzo(g h i)perylene
GC/MS	EPA 625; EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	1,1-Biphenyl
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroethyl) ether
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroisopropyl) ether (2, 2'-Oxybis(1-chloropropane)
GC/MS	EPA 625; EPA 8270C/D	bis(2-Ethylhexyl)adipate
GC/MS	EPA 625; EPA 8270C/D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270C/D	Butyl benzyl phthalate
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chlorobenzilate
GC/MS	EPA 625; EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Diallate
GC/MS	EPA 8270C/D	Dibenzo(a,j)acridine
GC/MS	EPA 625; EPA 8270C/D	Dibenz(a h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran
GC/MS	EPA 8270C/D	Diethyladipate
GC/MS	EPA 625; EPA 8270C/D	Diethyl phthalate

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Dimethoate
GC/MS	EPA 625; EPA 8270C/D	Dimethyl phthalate
GC/MS	EPA 625; EPA 8270C/D	Di-n-butyl phthalate
GC/MS	EPA 625; EPA 8270C/D	Di-n-octyl phthalate
GC/MS	EPA 8270C/D	Dinoseb
GC/MS	EPA 8270C/D	Disulfoton
GC/MS	EPA 8270C/D	Ethyl methanesulfonate
GC/MS	EPA 8270C/D	Ethyl parathion
GC/MS	EPA 8270C/D	Ethyl methacrylate
GC/MS	EPA 8270C/D	Famfur
GC/MS	EPA 625; EPA 8270C/D	Fluoranthene
GC/MS	EPA 625; EPA 8270C/D	Fluorene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorobenzene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorobutadiene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorocyclopentadiene
GC/MS	EPA 625; EPA 8270C/D	Hexachloroethane
GC/MS	EPA 8270C/D	Hexachlorophene
GC/MS	EPA 8270C/D	Hexachloropropene
GC/MS	EPA 625; EPA 8270C/D	Indeno(1, 2, 3-cd)pyrene
GC/MS	EPA 8270C/D	Isodrin
GC/MS	EPA 625; EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Isosafrole
GC/MS	EPA 8270C/D	Kepone
GC/MS	EPA 8270C/D	Methapyriline
GC/MS	EPA 8270C/D	Methy methanesulfonate
GC/MS	EPA 8270C/D	Methyl parathion
GC/MS	EPA 625; EPA 8270C/D	Naphthalene
GC/MS	EPA 625; EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	n-Nitrosodiethylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodimethylamine

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodi-n-propylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D	n-Nitrosomethylethylamine
GC/MS	EPA 8270C/D	n-Nitrosomorpholine
GC/MS	EPA 8270C/D	n-Nitrosopiperidine
GC/MS	EPA 8270C/D	n-Nitrosopyrrolidine
GC/MS	EPA 8270C/D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270C/D	o,o-Diethyl o-2pyrazinyl phosphorothioate
GC/MS	EPA 8270C/D	o-Toluidine
GC/MS	EPA 8270C/D	Pentachlorobenzene
GC/MS	EPA 8270C/D	Pentachloronitrobenzene
GC/MS	EPA 625; EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenacetin
GC/MS	EPA 625; EPA 8270C/D	Phenanthrene
GC/MS	EPA 625; EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Phorate
GC/MS	EPA 8270C/D	Pronamide
GC/MS	EPA 625; EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/MS	EPA 8270C/D	Safrole
GC/MS	EPA 8270C/D	Sulfotepp
GC/MS	EPA 8270C/D	Thionazin
GC/MS	EPA 625; EPA 8270C/D	3, 3'-Dichlorobenzidine
GC/MS	EPA 8270C/D	3, 3'-Dimethylbenzidine
GC/MS	EPA 8270C/D SIM	1,1'-Biphenyl
GC/MS	EPA 8270C/D SIM	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D SIM	1,4-Dioxane
GC/MS	EPA 8270C/D SIM	1-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2,2'-Oxybis(1-chloropropane
GC/MS	EPA 8270C/D SIM	2,3,4,6-Tetrachlorophenol

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4,6-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dimethylphenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrophenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2-Chloronaphthalene
GC/MS	EPA 8270C/D SIM	2-Chlorophenol
GC/MS	EPA 8270C/D SIM	2-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2-Methylphenol
GC/MS	EPA 8270C/D SIM	2-Nitroaniline
GC/MS	EPA 8270C/D SIM	2-Nitrophenol
GC/MS	EPA 8270C/D SIM	3&4-Methylphenol
GC/MS	EPA 8270C/D SIM	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/D SIM	3-Nitroaniline
GC/MS	EPA 8270C/D SIM	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270C/D SIM	4-Bromophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D SIM	4-Chloroaniline
GC/MS	EPA 8270C/D SIM	4-Chlorophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Nitroaniline
GC/MS	EPA 8270C/D SIM	4-Nitrophenol
GC/MS	EPA 8270C/D SIM	Acenaphthene
GC/MS	EPA 8270C/D SIM	Acenaphthylene
GC/MS	EPA 8270C/D SIM	Acetophenone
GC/MS	EPA 8270C/D SIM	Anthracene
GC/MS	EPA 8270C/D SIM	Atrazine
GC/MS	EPA 8270C/D SIM	Benzaldehyde
GC/MS	EPA 8270C/D SIM	Benzo(a)anthracene
GC/MS	EPA 8270C/D SIM	Benzo(a)pyrene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/D SIM	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270C/D SIM	Butylbenzylphthalate
GC/MS	EPA 8270C/D SIM	Caprolactam
GC/MS	EPA 8270C/D SIM	Carbazole
GC/MS	EPA 8270C/D SIM	Chrysene
GC/MS	EPA 8270C/D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270C/D SIM	Dibenzofuran
GC/MS	EPA 8270C/D SIM	Diethylphthalate
GC/MS	EPA 8270C/D SIM	Dimethyl phthalate
GC/MS	EPA 8270C/D SIM	Di-n-butylphthalate
GC/MS	EPA 8270C/D SIM	Di-n-octylphthalate
GC/MS	EPA 8270C/D SIM	Fluoranthene
GC/MS	EPA 8270C/D SIM	Fluorene
GC/MS	EPA 8270C/D SIM	Hexachlorobenzene
GC/MS	EPA 8270C/D SIM	Hexachlorobutadiene
GC/MS	EPA 8270C/D SIM	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D SIM	Hexachloroethane
GC/MS	EPA 8270C/D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D SIM	Isophorone
GC/MS	EPA 8270C/D SIM	Naphthalene
GC/MS	EPA 8270C/D SIM	Nitrobenzene
GC/MS	EPA 8270C/D SIM	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270C/D SIM	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D SIM	Pentachlorophenol
GC/MS	EPA 8270C/D SIM	Phenanthrene
GC/MS	EPA 8270C/D SIM	Phenol

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Pyrene
HPLC/UV	EPA 8330A/B	1, 3, 5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1, 3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2, 4, 6-Trinitrotoluene
HPLC/UV	EPA 8330A/B	2, 4-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Amino-4, 6 -Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	4-Amino-2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene
HPLC/UV	EPA 8330A/B	Ethylene glycol dinitrate (EGDN)
HPLC/UV	EPA 8330A/B	Hexahydro-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A MOD	Nitroglycerin
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	EPA 8330A/B	Tetryl
CVAA	EPA 245.1; EPA 7470A	Mercury
CVAF	EPA 1631E	Low Level Mercury
ICP/AES	EPA 200.7; EPA 6010B/C	Aluminum
ICP/AES	EPA 200.7; EPA 6010B/C	Antimony
ICP/AES	EPA 200.7; EPA 6010B/C	Arsenic
ICP/AES	EPA 200.7; EPA 6010B/C	Barium
ICP/AES	EPA 200.7; EPA 6010B/C	Beryllium
ICP/AES	EPA 200.7; EPA 6010B/C	Boron
ICP/AES	EPA 200.7; EPA 6010B/C	Cadmium
ICP/AES	EPA 200.7; EPA 6010B/C	Calcium
ICP/AES	EPA 200.7; EPA 6010B/C	Chromium

Non-Potable Water		
Technology	Method	Analyte
ICP/AES	EPA 200.7; EPA 6010B/C	Cobalt
ICP/AES	EPA 200.7; EPA 6010B/C	Copper
ICP/AES	EPA 200.7; EPA 6010B/C	Iron
ICP/AES	EPA 200.7; EPA 6010B/C	Lead
ICP/AES	EPA 200.7; EPA 6010B/C	Magnesium
ICP/AES	EPA 200.7; EPA 6010B/C	Manganese
ICP/AES	EPA 200.7; EPA 6010B/C	Molybdenum
ICP/AES	EPA 200.7; EPA 6010B/C	Nickel
ICP/AES	EPA 200.7; EPA 6010B/C	Potassium
ICP/AES	EPA 200.7; EPA 6010B/C	Selenium
ICP/AES	EPA 200.7; EPA 6010B/C	Silicon
ICP/AES	EPA 200.7; EPA 6010B/C	Silver
ICP/AES	EPA 200.7; EPA 6010B/C	Sodium
ICP/AES	EPA 6010B/C	Strontium
ICP/AES	EPA 200.7; EPA 6010B/C	Thallium
ICP/AES	EPA 200.7; EPA 6010B/C	Tin
ICP/AES	EPA 200.7; EPA 6010B/C	Titanium
ICP/AES	EPA 200.7; EPA 6010B/C	Vanadium
ICP/AES	EPA 200.7; EPA 6010B/C	Zinc
ICP/MS	EPA 200.8; EPA 6020A	Aluminum
ICP/MS	EPA 200.8; EPA 6020A	Antimony
ICP/MS	EPA 200.8; EPA 6020A	Arsenic
ICP/MS	EPA 200.8; EPA 6020A	Barium
ICP/MS	EPA 200.8; EPA 6020A	Beryllium
ICP/MS	EPA 200.8; EPA 6020A	Boron
ICP/MS	EPA 200.8; EPA 6020A	Cadmium
ICP/MS	EPA 200.8; EPA 6020A	Calcium
ICP/MS	EPA 200.8; EPA 6020A	Chromium
ICP/MS	EPA 200.8; EPA 6020A	Cobalt
ICP/MS	EPA 200.8; EPA 6020A	Copper
ICP/MS	EPA 200.8; EPA 6020A	Iron

Non-Potable Water		
Technology	Method	Analyte
ICP/MS	EPA 200.8; EPA 6020A	Lead
ICP/MS	EPA 200.8; EPA 6020A	Magnesium
ICP/MS	EPA 200.8; EPA 6020A	Manganese
ICP/MS	EPA 200.8; EPA 6020A	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A	Nickel
ICP/MS	EPA 200.8; EPA 6020A	Potassium
ICP/MS	EPA 200.8; EPA 6020A	Selenium
ICP/MS	EPA 200.8; EPA 6020A	Silicon
ICP/MS	EPA 200.8; EPA 6020A	Silver
ICP/MS	EPA 200.8; EPA 6020A	Sodium
ICP/MS	EPA 6020A	Strontium
ICP/MS	EPA 200.8; EPA 6020A	Thallium
ICP/MS	EPA 200.8; EPA 6020A	Tin
ICP/MS	EPA 200.8; EPA 6020A	Titanium
ICP/MS	EPA 200.8; EPA 6020A	Tungsten
ICP/MS	EPA 200.8	Uranium
ICP/MS	EPA 200.8; EPA 6020A	Vanadium
ICP/MS	EPA 200.8; EPA 6020A	Zinc
IC	EPA 300.0; EPA 9056A	Bromide
IC	EPA 300.0; EPA 9056A	Chloride
IC	EPA 300.0; EPA 9056A	Fluoride
IC	EPA 300.0; EPA 9056A	Nitrate as N
IC	EPA 300.0; EPA 9056A	Nitrite as N
IC	EPA 300.0; EPA 9056A	Nitrate + Nitrite
IC	EPA 300.0; EPA 9056A	Orthophosphate as P
IC	EPA 300.0; EPA 9056A	Sulfate
IC	SOP CA-776	Lactic Acid
IC	SOP CA-776	Acetic Acid
IC	SOP CA-776	Propionic Acid
IC	SOP CA-776	Formic Acid
IC	SOP CA-776	Butyric Acid

Non-Potable Water		
Technology	Method	Analyte
IC	SOP CA-776	Pyruvic Acid
IC	SOP CA-776	i-Pentanoic Acid
IC	SOP CA-776	Pentanoic Acid
IC	SOP CA-776	i-Hexanoic Acid
IC	SOP CA-776	Hexanoic Acid
Titration	EPA 310.1; SM 2320B	Alkalinity
Caculation	SM 2340B	Hardness
Gravimetric	EPA 1664A; EPA 9070A	Oil and Grease, Oil and Grease with SGT
Gravimetric	SM 2540B/C/D	Solids
ISE	EPA 120.1; SM 2510B	Conductivity
ISE	SM 2520B	Practical Salinity
ISE	SM 4500F- C	Fluoride
ISE	SM 4500H+ B	pH
ISE	SM 5210B	TBOD / CBOD
Physical	EPA 1010A	Ignitability
Physical	EPA 9040C	pH
Titration	SM 2340C	Hardness
Titration	SM 4500SO ₃ B	Sulfite
Titration	EPA 9034; SM 4500S ²⁻ F	Sulfide
Titration	EPA SW-846 Chapter 7.3.4	Reactive Sulfide
IR	EPA 9060A; SM 5310B	Total organic carbon
Turbidimetric	EPA 180.1; SM 2130B	Turbidity
Turbidimetric	EPA 9038; ASTM 516-02	Sulfate
UV/VIS	EPA 335.4; EPA 9012B; SM 4500-CN G	Amenable cyanide
UV/VIS	EPA 350.1; SM 4500NH ₃ H	Ammonia as N
UV/VIS	SM 3500Fe D	Ferrous Iron
UV/VIS	EPA 351.2	Kjeldahl nitrogen - total
UV/VIS	EPA 353.2; SM 4500NO ₃ F	Nitrate + Nitrite
UV/VIS	EPA 353.2; SM 4500NO ₃ F	Nitrate as N
UV/VIS	EPA 353.2; SM 4500NO ₃ F	Nitrite as N
UV/VIS	EPA 365.2; SM 4500P E	Orthophosphate as P

Non-Potable Water		
Technology	Method	Analyte
UV/VIS	EPA 365.4	Phosphorus total
UV/VIS	EPA 821/R-91-100	AVS-SEM
UV/VIS	EPA 410.4	COD
UV/VIS	EPA 420.1; EPA 9065	Total Phenolics
UV/VIS	SM 4500Cl G	Total Residual Chlorine
UV/VIS	SM 5540C	MBAS
UV/VIS	EPA 7196A; SM 3500-Cr D	Chromium VI
UV/VIS	EPA 9012B; EPA 335.4	Total Cyanide
UV/VIS	EPA 9251; SM 4500Cl E	Chloride
UV/VIS	EPA SW-846 Chapter 7.3.4	Reactive Cyanide

Preparation	Method	Type
Cleanup Methods	EPA 3640A	Gel Permeation Clean-up
Cleanup Methods	EPA 3630C	Silica Gel
Cleanup Methods	EPA 3660B	Sulfur Clean-Up
Cleanup Methods	EPA 3665A	Sulfuric Acid Clean-Up
Organic Preparation	EPA 3510C	Separatory Funnel Extraction
Organic Preparation	EPA 3520C	Continuous Liquid-Liquid Extraction
Inorganic Preparation	EPA 3010A	Hotblock
Volatile Organic Preparation	EPA 5030C	Purge and Trap

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8081B	2,4'-DDD
GC/ECD	EPA 8081B	2,4'-DDE
GC/ECD	EPA 8081B	2,4'-DDT
GC/ECD	EPA 8081B	4, 4'-DDD
GC/ECD	EPA 8081B	4, 4'-DDE
GC/ECD	EPA 8081B	4, 4'-DDT
GC/ECD	EPA 8081B	Aldrin

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Alpha-Chlordane
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	Cis-Nonachlor
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin Ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Hexachlorobenzene
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Mirex
GC/ECD	EPA 8081B	Oxychlordane
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8081B	Trans-Nonachlor
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A MOD	Aroclor-1262 (PCB-1262)

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8082A MOD	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5, 5', 6-Nonachlorobiphenyl (BZ 206)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5, 6-Octachlorobiphenyl (BZ 195)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5-Heptachlorobiphenyl (BZ 170)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4'-Hexachlorobiphenyl (BZ 128)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 180)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5', 6-Heptachlorobiphenyl (BZ 183)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5-Hexachlorobiphenyl (BZ 138)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 6, 6'-Heptachlorobiphenyl (BZ 184)
GC/ECD	EPA 8082A	2, 2', 3, 4', 5, 5', 6-Heptachlorobiphenyl (BZ 187)
GC/ECD	EPA 8082A	2, 2', 3, 4, 5'-Pentachlorobiphenyl (BZ 87)
GC/ECD	EPA 8082A	2, 2', 3, 5'-Tetrachlorobiphenyl (BZ 44)
GC/ECD	EPA 8082A	2, 2', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 153)
GC/ECD	EPA 8082A	2, 2', 4, 5, 5'-Pentachlorobiphenyl (BZ 101)
GC/ECD	EPA 8082A	2, 2', 4, 5-Tetrachlorobiphenyl (BZ 48)
GC/ECD	EPA 8082A	2, 2', 4, 5'-Tetrachlorobiphenyl (BZ 49)
GC/ECD	EPA 8082A	2, 2', 5, 5'-Tetrachlorobiphenyl (BZ 52)
GC/ECD	EPA 8082A	2, 2', 5-Trichlorobiphenyl (BZ 18)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5-Hexachlorobiphenyl (BZ 156)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5'-Hexachlorobiphenyl (BZ 157)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4'-Pentachlorobiphenyl (BZ 105)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 189)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 167)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 118)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5'-Pentachlorobiphenyl (BZ 123)
GC/ECD	EPA 8082A	2, 3', 4, 4'-Tetrachlorobiphenyl (BZ 66)
GC/ECD	EPA 8082A	2, 3, 4, 4', 5-Pentachlorobiphenyl (BZ 114)
GC/ECD	EPA 8082A	2, 4, 4'-Trichlorobiphenyl (BZ 28)
GC/ECD	EPA 8082A	2, 4'-Dichlorobiphenyl (BZ 8)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 169)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 126)

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8082A	3, 3', 4, 4'-Tetrachlorobiphenyl (BZ 77)
GC/ECD	EPA 8082A	3, 4, 4', 5-Tetrachlorobiphenyl (BZ 81)
GC/ECD	EPA 8082A	Decachlorobiphenyl (BZ 209)
GC/ECD	EPA 8151A	2, 4, 5-T
GC/ECD	EPA 8151A	2, 4-D
GC/ECD	EPA 8151A	2, 4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2, 4, 5-TP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Total Petroleum Hydrocarbons (TPH)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID/PID	MA DEP VPH	Volatile Organic Hydrocarbons
GC/FID	MA DEP EPH	Extractable Petroleum Hydrocarbons
GC/FID	MA DEP EPH EPA 3546	Extractable Petroleum Hydrocarbons Microwave Extraction Preparation
GC/FID	CT-ETPH	Total Petroleum Hydrocarbons
GC/FID	TNRCC Method 1005	Total Petroleum Hydrocarbons
GC/FID	FL-PRO	Petroleum Range Organics
GC/ECD	EPA 8011	1, 2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C	1, 1, 1, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/C	1, 1, 1-Trichloroethane
GC/MS	EPA 8260B/C	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C	1, 1-Dichloroethane

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	1, 1-Dichloroethylene
GC/MS	EPA 8260B/C	1, 1-Dichloropropene
GC/MS	EPA 8260B/C	1, 2, 3-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 2, 3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 2, 4-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C	1, 2-Dibromoethane
GC/MS	EPA 8260B/C	1, 2-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 2-Dichloroethane
GC/MS	EPA 8260B/C	1, 2-Dichloropropane
GC/MS	EPA 8260B/C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 3, 5-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 3-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 3-Dichloropropane
GC/MS	EPA 8260B/C	1, 4-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 4-Dioxane
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2, 2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	Carbon disulfide
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	cis-1, 2-Dichloroethene
GC/MS	EPA 8260B/C	cis-1, 3-Dichloropropene
GC/MS	EPA 8260B/C	cis-1,3-Dichloro-2-butene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C	Di-isopropylether
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethyl-t-butylether
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Iodomethane
GC/MS	EPA 8260B/C	Isobutyl alcohol
GC/MS	EPA 8260B/C	Isopropyl alcohol
GC/MS	EPA 8260B/C	Isopropyl benzene
GC/MS	EPA 8260B/C	m p-xylenes

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B, C	Methyl acetate
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	n-propylbenzene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	pentachloroethane
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Propionitrile
GC/MS	EPA 8260B/C	sec-butylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	t-Amylmethylether
GC/MS	EPA 8260B/C	tert-Butyl alcohol
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	trans-1, 2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1, 3-Dichloropropylene
GC/MS	EPA 8260B/C	Trans-1, 4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C SIM	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethene
GC/MS	EPA 8260B/C SIM	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C SIM	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C SIM	1,2-Dibromoethane
GC/MS	EPA 8260B/C SIM	1,2-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,2-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,3-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	2-Hexanone
GC/MS	EPA 8260B/C SIM	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C SIM	Benzene
GC/MS	EPA 8260B/C SIM	Bromodichloromethane
GC/MS	EPA 8260B/C SIM	Carbon Tetrachloride
GC/MS	EPA 8260B/C SIM	Chloroform
GC/MS	EPA 8260B/C SIM	Chloromethane
GC/MS	EPA 8260B/C SIM	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Dibromochloromethane
GC/MS	EPA 8260B/C SIM	Ethylbenzene
GC/MS	EPA 8260B/C SIM	Isopropylbenzene
GC/MS	EPA 8260B/C SIM	Hexachlorobutadiene
GC/MS	EPA 8260B/C SIM	Methylcyclohexane

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C SIM	m,p-Xylene
GC/MS	EPA 8260B/C SIM	o-Xylene
GC/MS	EPA 8260B/C SIM	Tetrachloroethene
GC/MS	EPA 8260B/C SIM	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	Trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Trichloroethene
GC/MS	EPA 8260B/C SIM	Trichlorofluoromethane
GC/MS	EPA 8260B/C SIM	Vinyl Chloride
GC/MS	EPA 8260B/C SIM	Xylenes (total)
GC/MS	EPA 8270C/D	1, 2, 4, 5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1, 3, 5-Trinitrobenzene
GC/MS	EPA 8270C/D	1, 3-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 3-Dinitrobenzene
GC/MS	EPA 8270C/D	1, 4-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 4-Dioxane
GC/MS	EPA 8270C/D	1, 4-Naphthoquinone
GC/MS	EPA 8270C/D	1, 4-Phenylenediamine
GC/MS	EPA 8270C/D	1,1-Biphenyl
GC/MS	EPA 8270C/D	1-Chloronaphthalene
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	1-Naphthylamine
GC/MS	EPA 8270C/D	2, 3, 4, 6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2, 4, 5-Trochlorophenol
GC/MS	EPA 8270C/D	2, 4, 6-Trichlorophenol
GC/MS	EPA 8270C/D	2, 4-Dichlorophenol
GC/MS	EPA 8270C/D	2, 4-Dimethylphenol
GC/MS	EPA 8270C/D	2, 4-Dinitrophenol
GC/MS	EPA 8270C/D	2, 4-Dinitrotoluene (2 4-DNT)

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	2, 6-Dichlorophenol
GC/MS	EPA 8270C/D	2, 6-Dinitrotoluene (2 6-DNT)
GC/MS	EPA 8270C/D	2-Acetylaminofluorene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methyl-4, 6-dinitrophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol
GC/MS	EPA 8270C/D	2-Naphthylamine
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol
GC/MS	EPA 8270C/D	2-Picoline
GC/MS	EPA 8270C/D	3, 3'-Dichlorobenzidine
GC/MS	EPA 8270C/D	3, 3'-Dimethylbenzidine
GC/MS	EPA 8270C/D	3,4-Methylphenol
GC/MS	EPA 8270C/D	3-Methylcholanthrene
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4-Aminobiphenyl
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C/D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270C/D	4-Nitroaniline
GC/MS	EPA 8270C/D	4-Nitrophenol
GC/MS	EPA 8270C/D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	5-Nitro-o-toluidine
GC/MS	EPA 8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	a a-Dimethylphenethylamine
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Acetophenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Aramite
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Azobenzene
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g h i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270C/D	bis(2-Chloroisopropyl) ether (2, 2'-Oxybis(1-chloropropane))
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270C/D	Bis(2-Ethylhexyl)adipate
GC/MS	EPA 8270C/D	Butyl benzyl phthalate
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chlorobenzilate
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Diallate
GC/MS	EPA 8270C/D	Dibenz(a h)anthracene
GC/MS	EPA 8270C/D	Dibenzo(a,j)acridine
GC/MS	EPA 8270C/D	Dibenzofuran
GC/MS	EPA 8270C/D	Diethyl phthalate
GC/MS	EPA 8270C/D	Diethyladipate

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Dimethoate
GC/MS	EPA 8270C/D	Dimethyl phthalate
GC/MS	EPA 8270C/D	Di-n-butyl phthalate
GC/MS	EPA 8270C/D	Di-n-octyl phthalate
GC/MS	EPA 8270C/D	Dinoseb
GC/MS	EPA 8270C/D	Disulfoton
GC/MS	EPA 8270C/D	Ethyl methacrylate
GC/MS	EPA 8270C/D	Ethyl methanesulfonate
GC/MS	EPA 8270C/D	Ethyl parathion
GC/MS	EPA 8270C/D	Famfur
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene
GC/MS	EPA 8270C/D	Hexachlorobutadiene
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D	Hexachloroethane
GC/MS	EPA 8270C/D	Hexachlorophene
GC/MS	EPA 8270C/D	Hexachloropropene
GC/MS	EPA 8270C/D	Indeno(1, 2, 3-cd)pyrene
GC/MS	EPA 8270C/D	Isodrin
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Isosafrole
GC/MS	EPA 8270C/D	Kepone
GC/MS	EPA 8270C/D	Methapyriline
GC/MS	EPA 8270C/D	Methyl methanesulfonate
GC/MS	EPA 8270C/D	Methyl parathion
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	n-Nitrosodiethylamine
GC/MS	EPA 8270C/D	n-Nitrosodimethylamine
GC/MS	EPA 8270C/D	n-Nitroso-di-n-butylamine

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270C/D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D	n-Nitrosomethylethylamine
GC/MS	EPA 8270C/D	n-Nitrosomorpholine
GC/MS	EPA 8270C/D	n-Nitrosopiperidine
GC/MS	EPA 8270C/D	n-Nitrosopyrrolidine
GC/MS	EPA 8270C/D	O, O, O-Triethyl phosphorothioate
GC/MS	EPA 8270C/D	o,o-Diethyl o-2-pyrazinyl phosphorothioate
GC/MS	EPA 8270C/D	o-Toluidine
GC/MS	EPA 8270C/D	Pentachlorobenzene
GC/MS	EPA 8270C/D	Pentachloronitrobenzene
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenacetin
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Phorate
GC/MS	EPA 8270C/D	Pronamide
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/MS	EPA 8270C/D	Safrole
GC/MS	EPA 8270C/D	Sulfotepp
GC/MS	EPA 8270C/D	Thionazin
GC/MS	EPA 8270C/D SIM	1,1'-Biphenyl
GC/MS	EPA 8270C/D SIM	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D SIM	1,4-Dioxane
GC/MS	EPA 8270C/D SIM	1-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2,2'-Oxybis(1-chloropropane
GC/MS	EPA 8270C/D SIM	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D SIM	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4,6-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dichlorophenol

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	2,4-Dimethylphenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrophenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2-Chloronaphthalene
GC/MS	EPA 8270C/D SIM	2-Chlorophenol
GC/MS	EPA 8270C/D SIM	2-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2-Methylphenol
GC/MS	EPA 8270C/D SIM	2-Nitroaniline
GC/MS	EPA 8270C/D SIM	2-Nitrophenol
GC/MS	EPA 8270C/D SIM	3&4-Methylphenol
GC/MS	EPA 8270C/D SIM	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/D SIM	3-Nitroaniline
GC/MS	EPA 8270C/D SIM	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270C/D SIM	4-Bromophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D SIM	4-Chloroaniline
GC/MS	EPA 8270C/D SIM	4-Chlorophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Nitroaniline
GC/MS	EPA 8270C/D SIM	4-Nitrophenol
GC/MS	EPA 8270C/D SIM	Acenaphthene
GC/MS	EPA 8270C/D SIM	Acenaphthylene
GC/MS	EPA 8270C/D SIM	Acetophenone
GC/MS	EPA 8270C/D SIM	Anthracene
GC/MS	EPA 8270C/D SIM	Atrazine
GC/MS	EPA 8270C/D SIM	Benzaldehyde
GC/MS	EPA 8270C/D SIM	Benzo(a)anthracene
GC/MS	EPA 8270C/D SIM	Benzo(a)pyrene
GC/MS	EPA 8270C/D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D SIM	Benzo(k)fluoranthene

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/D SIM	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270C/D SIM	Butylbenzylphthalate
GC/MS	EPA 8270C/D SIM	Caprolactam
GC/MS	EPA 8270C/D SIM	Carbazole
GC/MS	EPA 8270C/D SIM	Chrysene
GC/MS	EPA 8270C/D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270C/D SIM	Dibenzofuran
GC/MS	EPA 8270C/D SIM	Diethylphthalate
GC/MS	EPA 8270C/D SIM	Dimethyl phthalate
GC/MS	EPA 8270C/D SIM	Di-n-butylphthalate
GC/MS	EPA 8270C/D SIM	Di-n-octylphthalate
GC/MS	EPA 8270C/D SIM	Fluoranthene
GC/MS	EPA 8270C/D SIM	Fluorene
GC/MS	EPA 8270C/D SIM	Hexachlorobenzene
GC/MS	EPA 8270C/D SIM	Hexachlorobutadiene
GC/MS	EPA 8270C/D SIM	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D SIM	Hexachloroethane
GC/MS	EPA 8270C/D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D SIM	Isophorone
GC/MS	EPA 8270C/D SIM	Naphthalene
GC/MS	EPA 8270C/D SIM	Nitrobenzene
GC/MS	EPA 8270C/D SIM	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270C/D SIM	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D SIM	Pentachlorophenol
GC/MS	EPA 8270C/D SIM	Phenanthrene
GC/MS	EPA 8270C/D SIM	Phenol
GC/MS	EPA 8270C/D SIM	Pyrene
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene

Solid and Chemical Waste		
Technology	Method	Analyte
HPLC/UV	EPA 8330A	2, 4, 6-Trinitrotoluene
HPLC/UV	EPA 8330A	2, 4-Dinitrotoluene
HPLC/UV	EPA 8330A	2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4, 6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene
HPLC/UV	EPA 8330A	Ethylene glycol dinitrate (EGDN)
HPLC/UV	EPA 8330A	Hexahydr-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A MOD	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	EPA 8330A	Tetryl
HPLC/UV	8330B (W/O Soil Grinding)	1, 3, 5-Trinitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	1, 3-Dinitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	2, 4, 6-Trinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2, 4-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2, 6-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2-Amino-4, 6 –Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	3-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	3,5-Dinitroaniline
HPLC/UV	8330B (W/O Soil Grinding)	4-Amino-2,3-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	4-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	Ethylene glycol dinitrate (EGDN)
HPLC/UV	8330B (W/O Soil Grinding)	Hexahydr-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	8330B (W/O Soil Grinding)	Nitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	Nitroglycerin

Solid and Chemical Waste		
Technology	Method	Analyte
HPLC/UV	8330B (W/O Soil Grinding)	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	8330B (W/O Soil Grinding)	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	8330B (W/O Soil Grinding)	Tetryl
CVAA	EPA 7471B	Mercury
CVAf	EPA 1631E	Low Level Mercury
ICP/AES	EPA 6010B/C	Aluminum
ICP/AES	EPA 6010B/C	Antimony
ICP/AES	EPA 6010B/C	Arsenic
ICP/AES	EPA 6010B/C	Barium
ICP/AES	EPA 6010B/C	Beryllium
ICP/AES	EPA 6010B/C	Boron
ICP/AES	EPA 6010B/C	Cadmium
ICP/AES	EPA 6010B/C	Calcium
ICP/AES	EPA 6010B/C	Chromium
ICP/AES	EPA 6010B/C	Cobalt
ICP/AES	EPA 6010B/C	Copper
ICP/AES	EPA 6010B/C	Iron
ICP/AES	EPA 6010B/C	Lead
ICP/AES	EPA 6010B/C	Magnesium
ICP/AES	EPA 6010B/C	Manganese
ICP/AES	EPA 6010B/C	Molybdenum
ICP/AES	EPA 6010B/C	Nickel
ICP/AES	EPA 6010B/C	Potassium
ICP/AES	EPA 6010B/C	Selenium
ICP/AES	EPA 6010B/C	Silicon
ICP/AES	EPA 6010B/C	Silver
ICP/AES	EPA 6010B/C	Sodium
ICP/AES	EPA 6010B/C	Strontium
ICP/AES	EPA 6010B/C	Thallium
ICP/AES	EPA 6010B/C	Tin
ICP/AES	EPA 6010B/C	Titanium

Solid and Chemical Waste		
Technology	Method	Analyte
ICP/AES	EPA 6010B/C	Vanadium
ICP/AES	EPA 6010B/C	Zinc
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Boron
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Molybdenum
ICP/MS	EPA 6020A	Nickel
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Strontium
ICP/MS	EPA 6020A	Thallium
ICP/MS	EPA 6020A	Tin
ICP/MS	EPA 6020A	Titanium
ICP/MS	EPA 6020A	Tungsten
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
IC	EPA 9056A	Chloride

Solid and Chemical Waste		
Technology	Method	Analyte
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate as N
IC	EPA 9056A	Nitrite as N
IC	EPA 9056A	Orthophosphate
IC	EPA 9056A	Sulfate
Gravimetric	EPA 9071A; EPA 9071B	Oil and Grease, Oil and Grease with SGT
Physical	EPA 1010A	Ignitability
Physical	EPA 9045D	pH
Titration	EPA SW-846 Chapter 7.3.4	Reactive Sulfide
Titration	Walkley-Black	Total Organic Carbon
IR	Lloyd Kahn	Total organic carbon
Turbidimetric	EPA 9038; ASTM 516-02	Sulfate
UV/VIS	EPA 350.1; SM 4500NH3 H	Ammonia as N
UV/VIS	EPA 9251; SM 4500Cl E	Chloride
UV/VIS	EPA SW-846 Chapter 7.3.4	Reactive Cyanide
UV/VIS	EPA 821/R-91-100	AVS-SEM
UV/VIS	SM 3500Fe D	Ferrous Iron
Cleanup Methods	EPA 3630C	Silica Gel
UV/VIS	EPA 7196	Chromium VI
UV/VIS	EPA 7196A	Chromium VI
UV/VIS	EPA 9012B	Total cyanide
Preparation	Method	Type
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Cleanup Methods	EPA 3660B	Sulfur Clean-up
Cleanup Methods	EPA 3620C	Florsil Clean-up
Cleanup Methods	EPA 3630C	Silica Gel Clean-up
Cleanup Methods	EPA 3640A	GPC Clean-up
Organic Preparation	EPA 3540C	Soxhlet Extraction
Organic Preparation	EPA 3545A	Pressurized Fluid Extraction

Solid and Chemical Waste		
Technology	Method	Analyte
Organic Preparation	EPA 3546	Microwave Extraction Preparation for EPA 8082A, 8081B and 8270C, D
Organic Preparation	EPA 3550C	Sonication
Inorganics Preparation	EPA 3050B	Hotblock
Inorganics Preparation	EPA 3060A	Alkaline Digestion
Volatile Organics Preparation	EPA 5035/5035A	Closed System Purge and Trap

Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	Propene
GC/MS	EPA TO-15	1, 1, 1-Trichloroethane
GC/MS	EPA TO-15	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA TO-15	1, 1, 2-Trichloroethane
GC/MS	EPA TO-15	1, 1-Dichloroethane
GC/MS	EPA TO-15	1, 1-Dichloroethylene
GC/MS	EPA TO-15	1, 2, 4-Trichlorobenzene
GC/MS	EPA TO-15	1, 2, 4-Trimethylbenzene
GC/MS	EPA TO-15	1, 2-Dibromoethane (EDB)
GC/MS	EPA TO-15	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)
GC/MS	EPA TO-15	1, 2-Dichlorobenzene
GC/MS	EPA TO-15	1, 2-Dichloroethane
GC/MS	EPA TO-15	1, 2-Dichloroethenes (Total)
GC/MS	EPA TO-15	1, 2-Dichloropropane
GC/MS	EPA TO-15	1, 3, 5-Trimethylbenzene
GC/MS	EPA TO-15	1, 3-Butadiene
GC/MS	EPA TO-15	1, 3-Dichlorobenzene
GC/MS	EPA TO-15	1, 4-Dichlorobenzene
GC/MS	EPA TO-15	1,4-Difluorobenzene
GC/MS	EPA TO-15	1, 4-Dioxane
GC/MS	EPA TO-15	2-Butanone
GC/MS	EPA TO-15	2-Hexanone

Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	2-Propanol
GC/MS	EPA TO-15	4-Ethyltoluene
GC/MS	EPA TO-15	4-Methyl-2-pentanone
GC/MS	EPA TO-15	Acetone
GC/MS	EPA TO-15	Acrolein
GC/MS	EPA TO-15	Benzene
GC/MS	EPA TO-15	Benzyl chloride
GC/MS	EPA TO-15	Bromochloromethane
GC/MS	EPA TO-15	Bromodichloromethane
GC/MS	EPA TO-15	Bromoform
GC/MS	EPA TO-15	Carbon disulfide
GC/MS	EPA TO-15	Carbon tetrachloride
GC/MS	EPA TO-15	Chlorobenzene
GC/MS	EPA TO-15	Chloroethane
GC/MS	EPA TO-15	Chloroform
GC/MS	EPA TO-15	Cis-1, 2-Dichloroethene
GC/MS	EPA TO-15	Cis-1, 3-Dichloropropene
GC/MS	EPA TO-15	Cyclohexane
GC/MS	EPA TO-15	Dibromochloromethane
GC/MS	EPA TO-15	Dichlorodifluoromethane (Freon 12)
GC/MS	EPA TO-15	Ethanol
GC/MS	EPA TO-15	Ethyl acetate
GC/MS	EPA TO-15	Ethylbenzene
GC/MS	EPA TO-15	Hexachlorobutadiene
GC/MS	EPA TO-15	Isopropyl alcohol
GC/MS	EPA TO-15	m, p-Xylene
GC/MS	EPA TO-15	Methyl bromide (Bromomethane)
GC/MS	EPA TO-15	Methyl chloride (Chloromethane)
GC/MS	EPA TO-15	Methyl methacrylate
GC/MS	EPA TO-15	Methyl tert-butyl ether
GC/MS	EPA TO-15	Methylene chloride

Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	Naphthalene
GC/MS	EPA TO-15	n-Heptane
GC/MS	EPA TO-15	n-Hexane
GC/MS	EPA TO-15	o-Xylene
GC/MS	EPA TO-15	Styrene
GC/MS	EPA TO-15	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA TO-15	Tetrahydrofuran
GC/MS	EPA TO-15	Toluene
GC/MS	EPA TO-15	trans-1, 2-Dichloroethylene
GC/MS	EPA TO-15	trans-1, 3-Dichloropropylene
GC/MS	EPA TO-15	Trichloroethene (Trichloroethylene)
GC/MS	EPA TO-15	Trichlorofluoromethane (Freon 11)
GC/MS	EPA TO-15	1,1,2-Trichloro1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA TO-15	Vinyl acetate
GC/MS	EPA TO-15	Vinyl chloride
GC/MS	EPA TO-15	Xylenes (Total)
GC/MS	MA DEP APH	Aliphatic C5-C8 range
GC/MS	MA DEP APH	Aliphatic C9-C12 range
GC/MS	MA DEP APH	Aromatic C9-C10 range
GC/MS	MA DEP APH	1,3-Butadiene
GC/MS	MA DEP APH	Benzene
GC/MS	MA DEP APH	Ethylbenzene
GC/MS	MA DEP APH	m+p-Xylene
GC/MS	MA DEP APH	Methyl tert-butyl ether
GC/MS	MA DEP APH	Naphthalene
GC/MS	MA DEP APH	o-Xylene
GC/MS	MA DEP APH	Toluene

Notes:

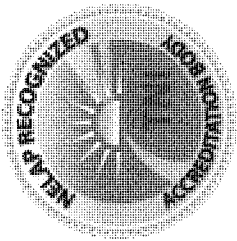
- 1) This laboratory offers commercial testing service.



Approved by: 
R. Douglas Leonard
Chief Technical Officer

Date: March 13, 2013

Re-issued: 2/1/13 Revised: 3/13/13



**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF GENERAL SERVICES
DIVISION OF CONSOLIDATED LABORATORY SERVICES**



Certifies that

**VA Laboratory ID#: 460179
KATAHDIN ANALYTICAL SERVICES, INC.
600 TECHNOLOGY WAY
SCARBOROUGH, ME 04074**

**Owner: MS. DAPHNE WARREN
Operator: MS. DEBORAH NADEAU
Responsible Official: MS. DAPHNE WARRER**

**Having met the requirements of 1 VAC 30-46
and the National Environmental Laboratory Accreditation Conference 2003 Standard
is hereby approved as an
Accredited Laboratory**

As more fully described in the attached Scope of Accreditation

**Effective Date: September 15, 2013
Expiration Date: September 14, 2014
Certificate # 2457**

Continued accreditation status depends on successful ongoing participation in the program.
Certificate to be conspicuously displayed at the laboratory.
Not valid unless accompanied by a valid Virginia Environmental Laboratory Accreditation Program (VELAP)
Scope of Accreditation.
Customers are urged to verify the laboratory's current accreditation status.

A handwritten signature in black ink, appearing to read "Thomas L. York".

**Thomas L. York, Ph.D., HCLD
DGS Deputy Director for Laboratories**



Commonwealth of Virginia
Department of General Services
Division of Consolidated Laboratory Services



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NON-POTABLE WATER

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ASTM D516-90,02	SULFATE	NH	EPA 1010 (9/86)	FLASHPOINT	NH
EPA 120.1 1982	CONDUCTIVITY	NH	EPA 160.4 1971	RESIDUE-VOLATILE	NH
EPA 1631 E 2002	MERCURY	NH	EPA 1664 A 1999	OIL & GREASE	NH
EPA 180.1 (AS HACH 8195)	TURBIDITY	NH	EPA 200.7 1994 4.4	ALUMINUM	NH
EPA 200.7 1994 4.4	ANTIMONY	NH	EPA 200.7 1994 4.4	ARSENIC	NH
EPA 200.7 1994 4.4	BARIUM	NH	EPA 200.7 1994 4.4	BERYLLIUM	NH
EPA 200.7 1994 4.4	BORON	NH	EPA 200.7 1994 4.4	CADMIUM	NH
EPA 200.7 1994 4.4	CALCIUM	NH	EPA 200.7 1994 4.4	CHROMIUM	NH
EPA 200.7 1994 4.4	COBALT	NH	EPA 200.7 1994 4.4	COPPER	NH
EPA 200.7 1994 4.4	IRON	NH	EPA 200.7 1994 4.4	LEAD	NH
EPA 200.7 1994 4.4	MAGNESIUM	NH	EPA 200.7 1994 4.4	MANGANESE	NH
EPA 200.7 1994 4.4	MOLYBDENUM	NH	EPA 200.7 1994 4.4	NICKEL	NH
EPA 200.7 1994 4.4	POTASSIUM	NH	EPA 200.7 1994 4.4	SELENIUM	NH
EPA 200.7 1994 4.4	SILICA AS SIO2	NH	EPA 200.7 1994 4.4	SILVER	NH
EPA 200.7 1994 4.4	SODIUM	NH	EPA 200.7 1994 4.4	THALLIUM	NH
EPA 200.7 1994 4.4	TIN	NH	EPA 200.7 1994 4.4	TOTAL HARDNESS AS CaCO3	NH
EPA 200.7 1994 4.4	VANADIUM	NH	EPA 200.7 1994 4.4	ZINC	NH
EPA 200.8 1994 5.4	ALUMINUM	NH	EPA 200.8 1994 5.4	ANTIMONY	NH
EPA 200.8 1994 5.4	ARSENIC	NH	EPA 200.8 1994 5.4	BARIUM	NH
EPA 200.8 1994 5.4	BERYLLIUM	NH	EPA 200.8 1994 5.4	CADMIUM	NH
EPA 200.8 1994 5.4	CHROMIUM	NH	EPA 200.8 1994 5.4	COBALT	NH
EPA 200.8 1994 5.4	COPPER	NH	EPA 200.8 1994 5.4	LEAD	NH
EPA 200.8 1994 5.4	MANGANESE	NH	EPA 200.8 1994 5.4	MOLYBDENUM	NH
EPA 200.8 1994 5.4	NICKEL	NH	EPA 200.8 1994 5.4	SELENIUM	NH
EPA 200.8 1994 5.4	SILVER	NH	EPA 200.8 1994 5.4	THALLIUM	NH
EPA 200.8 1994 5.4	VANADIUM	NH	EPA 200.8 1994 5.4	ZINC	NH
EPA 200.8 - EXTENDED 1994 5.4	BORON	NH	EPA 200.8 - EXTENDED 1994 5.4	TIN	NH
EPA 245.1 1994 3	MERCURY	NH	EPA 300.0 1993 2.1	BROMIDE	NH
EPA 300.0 1993 2.1	CHLORIDE	NH	EPA 300.0 1993 2.1	NITRATE AS N	NH
EPA 300.0 1993 2.1	NITRATE/NITRITE	NH	EPA 300.0 1993 2.1	NITRITE AS N	NH
EPA 300.0 1993 2.1	ORTHOPHOSPHATE AS P	NH	EPA 300.0 1993 2.1	SULFATE	NH
EPA 335.4 1993	CYANIDE	NH	EPA 350.1 1993 2	AMMONIA AS N	NH
EPA 351.1 1978	KJELDAHL NITROGEN - TOTAL	NH	EPA 353.2 1993 2	NITRATE AS N	NH
EPA 353.2 1993 2	NITRATE/NITRITE	NH	EPA 353.2 1993 2	NITRITE AS N	NH
EPA 365.1 1993 2	ORTHOPHOSPHATE AS P	NH	EPA 365.4 1974	PHOSPHORUS, TOTAL	NH
EPA 410.4 1993 2	CHEMICAL OXYGEN DEMAND	NH	EPA 420.1 1978	TOTAL PHENOLICS	NH
EPA 6010 B 1996	ALUMINUM	NH	EPA 6010 B 1996	ANTIMONY	NH

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NON-POTABLE WATER

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EPA 6010 B 1996	ARSENIC	NH	EPA 6010 B 1996	BARIUM	NH
EPA 6010 B 1996	BERYLLIUM	NH	EPA 6010 B 1996	BORON	NH
EPA 6010 B 1996	CADMIUM	NH	EPA 6010 B 1996	CALCIUM	NH
EPA 6010 B 1996	CHROMIUM	NH	EPA 6010 B 1996	COBALT	NH
EPA 6010 B 1996	COPPER	NH	EPA 6010 B 1996	IRON	NH
EPA 6010 B 1996	LEAD	NH	EPA 6010 B 1996	MAGNESIUM	NH
EPA 6010 B 1996	MANGANESE	NH	EPA 6010 B 1996	MOLYBDENUM	NH
EPA 6010 B 1996	NICKEL	NH	EPA 6010 B 1996	POTASSIUM	NH
EPA 6010 B 1996	SELENIUM	NH	EPA 6010 B 1996	SILVER	NH
EPA 6010 B 1996	SODIUM	NH	EPA 6010 B 1996	THALLIUM	NH
EPA 6010 B 1996	TIN	NH	EPA 6010 B 1996	VANADIUM	NH
EPA 6010 B 1996	ZINC	NH	EPA 6010 C 2007	ALUMINUM	NH
EPA 6010 C 2007	ANTIMONY	NH	EPA 6010 C 2007	ARSENIC	NH
EPA 6010 C 2007	BARIUM	NH	EPA 6010 C 2007	BERYLLIUM	NH
EPA 6010 C 2007	BORON	NH	EPA 6010 C 2007	CALCIUM	NH
EPA 6010 C 2007	CHROMIUM	NH	EPA 6010 C 2007	COBALT	NH
EPA 6010 C 2007	COPPER	NH	EPA 6010 C 2007	IRON	NH
EPA 6010 C 2007	LEAD	NH	EPA 6010 C 2007	MAGNESIUM	NH
EPA 6010 C 2007	MANGANESE	NH	EPA 6010 C 2007	MOLYBDENUM	NH
EPA 6010 C 2007	NICKEL	NH	EPA 6010 C 2007	POTASSIUM	NH
EPA 6010 C 2007	SELENIUM	NH	EPA 6010 C 2007	SILVER	NH
EPA 6010 C 2007	SODIUM	NH	EPA 6010 C 2007	THALLIUM	NH
EPA 6010 C 2007	TIN	NH	EPA 6010 C 2007	VANADIUM	NH
EPA 6010 C 2007	ZINC	NH	EPA 6020 A (2/07)	ALUMINUM	NH
EPA 6020 A (2/07)	ANTIMONY	NH	EPA 6020 A (2/07)	ARSENIC	NH
EPA 6020 A (2/07)	BARIUM	NH	EPA 6020 A (2/07)	BERYLLIUM	NH
EPA 6020 A (2/07)	CADMIUM	NH	EPA 6020 A (2/07)	CALCIUM	NH
EPA 6020 A (2/07)	CHROMIUM	NH	EPA 6020 A (2/07)	COBALT	NH
EPA 6020 A (2/07)	COPPER	NH	EPA 6020 A (2/07)	LEAD	NH
EPA 6020 A (2/07)	MANGANESE	NH	EPA 6020 A (2/07)	NICKEL	NH
EPA 6020 A (2/07)	SELENIUM	NH	EPA 6020 A (2/07)	SILVER	NH
EPA 6020 A (2/07)	THALLIUM	NH	EPA 6020 A (2/07)	VANADIUM	NH
EPA 6020 A (2/07)	ZINC	NH	EPA 6020 A - EXTENDED (2/07)	MOLYBDENUM	NH
EPA 608	4,4'-DDD	NH	EPA 608	4,4'-DDE	NH
EPA 608	4,4'-DDT	NH	EPA 608	ALDRIN	NH
EPA 608	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEX ANE)	NH	EPA 608	AROCLOR-1016 (PCB-1016)	NH
EPA 608	AROCLOR-1221 (PCB-1221)	NH	EPA 608	AROCLOR-1232 (PCB-1232)	NH

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EPA 608	AROCLOR-1242 (PCB-1242)	NH	EPA 608	AROCLOR-1248 (PCB-1248)	NH
EPA 608	AROCLOR-1254 (PCB-1254)	NH	EPA 608	AROCLOR-1260 (PCB-1260)	NH
EPA 608	BETA-BHC (BETA-HEXACHLOROCYCLOHEXANE)	NH	EPA 608	CHLORDANE (TECH.)	NH
EPA 608	DELTA-BHC	NH	EPA 608	DIELDRIN	NH
EPA 608	ENDOSULFAN I	NH	EPA 608	ENDOSULFAN II	NH
EPA 608	ENDOSULFAN SULFATE	NH	EPA 608	ENDRIN	NH
EPA 608	ENDRIN ALDEHYDE	NH	EPA 608	GAMMA-BHC (LINDANE, GAMMA-HEXACHLOROCYCLOHEXANE)	NH
EPA 608	HEPTACHLOR	NH	EPA 608	HEPTACHLOR EPOXIDE	NH
EPA 608	TOXAPHENE (CHLORINATED CAMPHENE)	NH	EPA 624	1,1,1-TRICHLOROETHANE	NH
EPA 624	1,1,2,2-TETRACHLOROETHANE	NH	EPA 624	1,1,2-TRICHLOROETHANE	NH
EPA 624	1,1-DICHLOROETHANE	NH	EPA 624	1,2-DICHLOROBENZENE	NH
EPA 624	1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	NH	EPA 624	1,2-DICHLOROPROPANE	NH
EPA 624	1,3-DICHLOROBENZENE	NH	EPA 624	1,4-DICHLOROBENZENE	NH
EPA 624	2-CHLOROETHYL VINYL ETHER	NH	EPA 624	ACROLEIN (PROPENAL)	NH
EPA 624	ACRYLONITRILE	NH	EPA 624	BENZENE	NH
EPA 624	BROMODICHLOROMETHANE	NH	EPA 624	BROMOFORM	NH
EPA 624	CARBON TETRACHLORIDE	NH	EPA 624	CHLOROBENZENE	NH
EPA 624	CHLORODIBROMOMETHANE	NH	EPA 624	CHLOROETHANE (ETHYL CHLORIDE)	NH
EPA 624	CHLOROFORM	NH	EPA 624	CIS-1,3-DICHLOROPROPENE	NH
EPA 624	ETHYLBENZENE	NH	EPA 624	METHYL BROMIDE (BROMOMETHANE)	NH
EPA 624	METHYL CHLORIDE (CHLOROMETHANE)	NH	EPA 624	METHYLENE CHLORIDE (DICHLOROMETHANE)	NH
EPA 624	TETRACHLOROETHENE (PERCHLOROETHENE)	NH	EPA 624	TOLUENE	NH
EPA 624	TRANS-1,2-DICHLOROETHENE	NH	EPA 624	TRANS-1,3-DICHLOROPROPENE	NH
EPA 624	TRICHLOROETHENE (TRICHLOROETHYLENE)	NH	EPA 624	TRICHLOROFLUOROMETHANE (FLUOROTRICHLOROMETHANE, FREON 11)	NH
EPA 624	VINYL CHLORIDE	NH	EPA 624 - EXTENDED	1,1-DICHLOROETHYLENE	NH
EPA 625 1982	1,2,4-TRICHLOROBENZENE	NH	EPA 625 1982	2,4,6-TRICHLOROPHENOL	NH
EPA 625 1982	2,4-DICHLOROPHENOL	NH	EPA 625 1982	2,4-DIMETHYLPHENOL	NH
EPA 625 1982	2,4-DINITROPHENOL	NH	EPA 625 1982	2,4-DINITROTOLUENE (2,4-DNT)	NH
EPA 625 1982	2,6-DINITROTOLUENE (2,6-DNT)	NH	EPA 625 1982	2-CHLORONAPHTHALENE	NH
EPA 625 1982	2-CHLOROPHENOL	NH	EPA 625 1982	2-METHYL-4,6-DINITROPHENOL (4,6-DINITRO-2-METHYLPHENOL)	NH
EPA 625 1982	2-NITROPHENOL	NH	EPA 625 1982	3,3'-DICHLOROBENZIDINE	NH

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NON-POTABLE WATER

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EPA 625 1982	4-CHLORO-3-METHYLPHENOL	NH	EPA 625 1982	4-CHLOROPHENYL PHENYLETHER	NH
EPA 625 1982	4-NITROPHENOL	NH	EPA 625 1982	ACENAPHTHENE	NH
EPA 625 1982	ACENAPHTHYLENE	NH	EPA 625 1982	ANTHRACENE	NH
EPA 625 1982	BENZIDINE	NH	EPA 625 1982	BENZO(A)ANTHRACENE	NH
EPA 625 1982	BENZO(A)PYRENE	NH	EPA 625 1982	BENZO(G,H,I)PERYLENE	NH
EPA 625 1982	BENZO(K)FLUORANTHENE	NH	EPA 625 1982	BENZO[B]FLUORANTHENE	NH
EPA 625 1982	BIS(2-CHLOROETHOXY)METHANE	NH	EPA 625 1982	BIS(2-CHLOROETHYL) ETHER	NH
EPA 625 1982	BIS(2-CHLOROISOPROPYL) ETHER	NH	EPA 625 1982	BIS(2-ETHYLHEXYL) PHTHALATE (DI(2-ETHYLHEXYL)PHTHALATE), (DEHP)	NH
EPA 625 1982	BUTYL BENZYL PHTHALATE	NH	EPA 625 1982	CHRYSENE	NH
EPA 625 1982	DI-N-BUTYL PHTHALATE	NH	EPA 625 1982	DI-N-OCTYL PHTHALATE	NH
EPA 625 1982	DIBENZO(A,H) ANTHRACENE	NH	EPA 625 1982	DIETHYL PHTHALATE	NH
EPA 625 1982	DIMETHYL PHTHALATE	NH	EPA 625 1982	FLUORANTHENE	NH
EPA 625 1982	FLUORENE	NH	EPA 625 1982	HEXACHLOROBENZENE	NH
EPA 625 1982	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH	EPA 625 1982	HEXACHLOROCYCLOPENTADIEN E	NH
EPA 625 1982	HEXACHLOROETHANE	NH	EPA 625 1982	INDENO(1,2,3-CD) PYRENE	NH
EPA 625 1982	ISOPHORONE	NH	EPA 625 1982	N-NITROSODI-N-PROPYLAMINE	NH
EPA 625 1982	N-NITROSODIMETHYLAMINE	NH	EPA 625 1982	N-NITROSODIPHENYLAMINE	NH
EPA 625 1982	NAPHTHALENE	NH	EPA 625 1982	NITROBENZENE	NH
EPA 625 1982	PENTACHLOROPHENOL	NH	EPA 625 1982	PHENANTHRENE	NH
EPA 625 1982	PHENOL	NH	EPA 625 1982	PYRENE	NH
EPA 625 - EXTENDED 1982	4-METHYLPHENOL (P-CRESOL)	NH	EPA 7196 A 1992	CHROMIUM VI	NH
EPA 7470 A 1994	MERCURY	NH	EPA 8011 (7/92)	1,2-DIBROMO-3-CHLOROPROPAN E (DBCP)	NH
EPA 8011 (7/92)	1,2-DIBROMOETHANE (EDB, ETHYLENE DIBROMIDE)	NH	EPA 8015 C 2000	DIESEL RANGE ORGANICS (DRO)	NH
EPA 8015 C 2000	ETHANOL	NH	EPA 8015 C 2000	ETHYLENE GLYCOL	NH
EPA 8015 C 2000	GASOLINE RANGE ORGANICS (GRO)	NH	EPA 8015 C 2000	ISOBUTYL ALCOHOL (2-METHYL-1-PROPANOL)	NH
EPA 8015 C 2000	ISOPROPYL ALCOHOL (2-PROPANOL, ISOPROPANOL)	NH	EPA 8015 C 2000	METHANOL	NH
EPA 8015 C 2000	N-PROPANOL (1-PROPANOL)	NH	EPA 8081 B (2/07)	4,4'-DDD	NH
EPA 8081 B (2/07)	4,4'-DDE	NH	EPA 8081 B (2/07)	4,4'-DDT	NH
EPA 8081 B (2/07)	ALDRIN	NH	EPA 8081 B (2/07)	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEX ANE)	NH
EPA 8081 B (2/07)	ALPHA-CHLORDANE [CIS-CHLORDANE]	NH	EPA 8081 B (2/07)	BETA-BHC (BETA-HEXACHLOROCYCLOHEXA NE)	NH
EPA 8081 B (2/07)	CHLORDANE (TECH.)	NH	EPA 8081 B (2/07)	DELTA-BHC	NH

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EPA 8081 B (2/07)	DIELDRIN	NH	EPA 8081 B (2/07)	ENDOSULFAN I	NH
EPA 8081 B (2/07)	ENDOSULFAN II	NH	EPA 8081 B (2/07)	ENDOSULFAN SULFATE	NH
EPA 8081 B (2/07)	ENDRIN	NH	EPA 8081 B (2/07)	ENDRIN ALDEHYDE	NH
EPA 8081 B (2/07)	ENDRIN KETONE	NH	EPA 8081 B (2/07)	GAMMA-BHC (LINDANE, GAMMA-HEXACHLOROCYCLOHEX ANE)	NH
EPA 8081 B (2/07)	GAMMA-CHLORDANE [BETA-CHLORDANE, TRANS-CHLORDANE]	NH	EPA 8081 B (2/07)	HEPTACHLOR	NH
EPA 8081 B (2/07)	HEPTACHLOR EPOXIDE	NH	EPA 8081 B (2/07)	METHOXYCHLOR	NH
EPA 8081 B (2/07)	TOXAPHENE (CHLORINATED CAMPHENE)	NH	EPA 8082 A (2/07)	2,2',3,3',4,4',5,5',6-NONACHLOROBI PHENYL (BZ-206)	NH
EPA 8082 A (2/07)	2,2',3,3',4,4',5-HEPTACHLOROBIPH ENYL (BZ-170)	NH	EPA 8082 A (2/07)	2,2',3,4',5,5',6-HEPTACHLOROBIPH ENYL (BZ-187)	NH
EPA 8082 A (2/07)	2,2',3,4,4',5,6-HEPTACHLOROBIPH ENYL (BZ-183)	NH	EPA 8082 A (2/07)	2,2',3,4,4',5'-HEXACHLOROBIPHEN YL (BZ-138)	NH
EPA 8082 A (2/07)	2,2',3,4,4',5,5'-HEPTACHLOROBIPH ENYL (BZ-180)	NH	EPA 8082 A (2/07)	2,2',3,4,4',5'-PENTACHLOROBIPHEN YL (BZ-87)	NH
EPA 8082 A (2/07)	2,2',3,5'-TETRACHLOROBIPHENYL (BZ-44)	NH	EPA 8082 A (2/07)	2,2',4,4',5,5'-HEXACHLOROBIPHEN YL (BZ-153)	NH
EPA 8082 A (2/07)	2,2',4,5,5'-PENTACHLOROBIPHEN YL (BZ-101)	NH	EPA 8082 A (2/07)	2,2',5,5'-TETRACHLOROBIPHENYL (BZ-52)	NH
EPA 8082 A (2/07)	2,2',5-TRICHLOROBIPHENYL (BZ-18)	NH	EPA 8082 A (2/07)	2,3',4,4'-TETRACHLOROBIPHENYL (BZ-66)	NH
EPA 8082 A (2/07)	AROCLOR-1016 (PCB-1016)	NH	EPA 8082 A (2/07)	AROCLOR-1221 (PCB-1221)	NH
EPA 8082 A (2/07)	AROCLOR-1232 (PCB-1232)	NH	EPA 8082 A (2/07)	AROCLOR-1242 (PCB-1242)	NH
EPA 8082 A (2/07)	AROCLOR-1248 (PCB-1248)	NH	EPA 8082 A (2/07)	AROCLOR-1254 (PCB-1254)	NH
EPA 8082 A (2/07)	AROCLOR-1260 (PCB-1260)	NH	EPA 8082 A - EXTENDED (2/07)	DECACHLOROBIPHENYL (BZ-209)	NH
EPA 8151 A (12/96)	2,4,5-T	NH	EPA 8151 A (12/96)	2,4-D	NH
EPA 8151 A (12/96)	2,4-DB	NH	EPA 8151 A (12/96)	DALAPON	NH
EPA 8151 A (12/96)	DICAMBA	NH	EPA 8151 A (12/96)	DICHLOROPROP (DICHLOROPROP)	NH
EPA 8151 A (12/96)	DINOSEB (2-SEC-BUTYL-4,6-DINITROPHENO L, DNBP)	NH	EPA 8151 A (12/96)	MCPA	NH
EPA 8151 A (12/96)	MCPP	NH	EPA 8151 A (12/96)	SILVEX (2,4,5-TP)	NH
EPA 8260 B 1996	1,1,1,2-TETRACHLOROETHANE	NH	EPA 8260 B 1996	1,1,1-TRICHLOROETHANE	NH
EPA 8260 B 1996	1,1,2,2-TETRACHLOROETHANE	NH	EPA 8260 B 1996	1,1,2-TRICHLOROETHANE	NH
EPA 8260 B 1996	1,1-DICHLOROETHANE	NH	EPA 8260 B 1996	1,1-DICHLOROETHYLENE	NH
EPA 8260 B 1996	1,1-DICHLOROPROPENE	NH	EPA 8260 B 1996	1,2,3-TRICHLOROBENZENE	NH
EPA 8260 B 1996	1,2,3-TRICHLOROPROPANE	NH	EPA 8260 B 1996	1,2,4-TRICHLOROBENZENE	NH
EPA 8260 B 1996	1,2,4-TRIMETHYLBENZENE	NH	EPA 8260 B 1996	1,2-DIBROMO-3-CHLOROPROPAN E (DBCP)	NH
EPA 8260 B 1996	1,2-DIBROMOETHANE (EDB, ETHYLENE DIBROMIDE)	NH	EPA 8260 B 1996	1,2-DICHLOROBENZENE	NH

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EPA 8260 B 1996	1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	NH	EPA 8260 B 1996	1,2-DICHLOROPROPANE	NH
EPA 8260 B 1996	1,3,5-TRIMETHYLBENZENE	NH	EPA 8260 B 1996	1,3-DICHLOROBENZENE	NH
EPA 8260 B 1996	1,3-DICHLOROPROPANE	NH	EPA 8260 B 1996	1,4-DICHLOROBENZENE	NH
EPA 8260 B 1996	1,4-DIOXANE (1,4-DIETHYLENEOXIDE)	NH	EPA 8260 B 1996	2,2-DICHLOROPROPANE	NH
EPA 8260 B 1996	2-BUTANONE (METHYL ETHYL KETONE, MEK)	NH	EPA 8260 B 1996	2-CHLOROETHYL VINYL ETHER	NH
EPA 8260 B 1996	2-CHLOROTOLUENE	NH	EPA 8260 B 1996	2-HEXANONE	NH
EPA 8260 B 1996	4-CHLOROTOLUENE	NH	EPA 8260 B 1996	4-ISOPROPYLTOLUENE (P-CYME)	NH
EPA 8260 B 1996	4-METHYL-2-PENTANONE (MIBK)	NH	EPA 8260 B 1996	ACETONE	NH
EPA 8260 B 1996	ACETONITRILE	NH	EPA 8260 B 1996	ACROLEIN (PROPENAL)	NH
EPA 8260 B 1996	ACRYLONITRILE	NH	EPA 8260 B 1996	ALLYL CHLORIDE (3-CHLOROPROPENE)	NH
EPA 8260 B 1996	BENZENE	NH	EPA 8260 B 1996	BROMOBENZENE	NH
EPA 8260 B 1996	BROMOCHLOROMETHANE	NH	EPA 8260 B 1996	BROMODICHLOROMETHANE	NH
EPA 8260 B 1996	BROMOFORM	NH	EPA 8260 B 1996	CARBON DISULFIDE	NH
EPA 8260 B 1996	CARBON TETRACHLORIDE	NH	EPA 8260 B 1996	CHLOROBENZENE	NH
EPA 8260 B 1996	CHLORODIBROMOMETHANE	NH	EPA 8260 B 1996	CHLOROETHANE (ETHYL CHLORIDE)	NH
EPA 8260 B 1996	CHLOROFORM	NH	EPA 8260 B 1996	CIS-1,2-DICHLOROETHYLENE	NH
EPA 8260 B 1996	CIS-1,3-DICHLOROPROPENE	NH	EPA 8260 B 1996	DIBROMOMETHANE (METHYLENE BROMIDE)	NH
EPA 8260 B 1996	DICHLORODIFLUOROMETHANE (FREON-12)	NH	EPA 8260 B 1996	DIETHYL ETHER	NH
EPA 8260 B 1996	ETHYL METHACRYLATE	NH	EPA 8260 B 1996	ETHYL-T-BUTYLETHER (2-ETHOXY-2-METHYLPROPANE, ETBE)	NH
EPA 8260 B 1996	ETHYLBENZENE	NH	EPA 8260 B 1996	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH
EPA 8260 B 1996	IODOMETHANE (METHYL IODIDE)	NH	EPA 8260 B 1996	ISOBUTYL ALCOHOL (2-METHYL-1-PROPANOL)	NH
EPA 8260 B 1996	METHACRYLONITRILE	NH	EPA 8260 B 1996	METHYL BROMIDE (BROMOMETHANE)	NH
EPA 8260 B 1996	METHYL CHLORIDE (CHLOROMETHANE)	NH	EPA 8260 B 1996	METHYL METHACRYLATE	NH
EPA 8260 B 1996	METHYL TERT-BUTYL ETHER (MTBE)	NH	EPA 8260 B 1996	METHYLENE CHLORIDE (DICHLOROMETHANE)	NH
EPA 8260 B 1996	N-BUTYLBENZENE	NH	EPA 8260 B 1996	N-PROPYLBENZENE	NH
EPA 8260 B 1996	NAPHTHALENE	NH	EPA 8260 B 1996	PENTACHLOROETHANE	NH
EPA 8260 B 1996	PROPIONITRILE (ETHYL CYANIDE)	NH	EPA 8260 B 1996	SEC-BUTYLBENZENE	NH
EPA 8260 B 1996	STYRENE	NH	EPA 8260 B 1996	TERT-BUTYL ALCOHOL	NH
EPA 8260 B 1996	TERT-BUTYLBENZENE	NH	EPA 8260 B 1996	TETRACHLOROETHENE (PERCHLOROETHENE)	NH
EPA 8260 B 1996	TOLUENE	NH			

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EPA 8260 B 1996	TRANS-1,2-DICHLOROETHENE	NH	EPA 8260 B 1996	TRANS-1,3-DICHLOROPROPENE	NH
EPA 8260 B 1996	TRANS-1,4-DICHLORO-2-BUTENE	NH	EPA 8260 B 1996	TRICHLOROETHENE (TRICHLOROETHYLENE)	NH
EPA 8260 B 1996	TRICHLOROFUOROMETHANE (FLUOROTRICHLOROMETHANE, FREON 11)	NH	EPA 8260 B 1996	VINYL ACETATE	NH
EPA 8260 B 1996	VINYL CHLORIDE	NH	EPA 8260 B 1996	XYLENE (TOTAL)	NH
EPA 8260 B - EXTENDED 1996	1,1,2-TRICHLORO-1,2,2-TRIFLUOR OETHANE (FREON 113)	NH	EPA 8260 B - EXTENDED 1996	DI-ISOPROPYLETHET (DIPE, ISOPROPYL ETHER)	NH
EPA 8260 B - EXTENDED 1996	T-AMYL METHYLETHET (TAME)	NH	EPA 8260 C 2006	1,1,1,2-TETRACHLOROETHANE	NH
EPA 8260 C 2006	1,1,1-TRICHLOROETHANE	NH	EPA 8260 C 2006	1,1,2,2-TETRACHLOROETHANE	NH
EPA 8260 C 2006	1,1,2-TRICHLOROETHANE	NH	EPA 8260 C 2006	1,1-DICHLOROETHANE	NH
EPA 8260 C 2006	1,1-DICHLOROETHYLENE	NH	EPA 8260 C 2006	1,1-DICHLOROPROPENE	NH
EPA 8260 C 2006	1,2,3-TRICHLOROBENZENE	NH	EPA 8260 C 2006	1,2,3-TRICHLOROPROPANE	NH
EPA 8260 C 2006	1,2,4-TRIMETHYLBENZENE	NH	EPA 8260 C 2006	1,2-DIBROMO-3-CHLOROPROPAN E (DBCP)	NH
EPA 8260 C 2006	1,2-DIBROMOETHANE (EDB, ETHYLENE DIBROMIDE)	NH	EPA 8260 C 2006	1,2-DICHLOROBENZENE	NH
EPA 8260 C 2006	1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	NH	EPA 8260 C 2006	1,2-DICHLOROPROPANE	NH
EPA 8260 C 2006	1,3,5-TRIMETHYLBENZENE	NH	EPA 8260 C 2006	1,3-DICHLOROBENZENE	NH
EPA 8260 C 2006	1,3-DICHLOROPROPANE	NH	EPA 8260 C 2006	1,4-DICHLOROBENZENE	NH
EPA 8260 C 2006	1,4-DIOXANE (1,4- DIETHYLENEOXIDE)	NH	EPA 8260 C 2006	2,2-DICHLOROPROPANE	NH
EPA 8260 C 2006	2-BUTANONE (METHYL ETHYL KETONE, MEK)	NH	EPA 8260 C 2006	2-CHLOROETHYL VINYL ETHER	NH
EPA 8260 C 2006	2-CHLOROTOLUENE	NH	EPA 8260 C 2006	2-HEXANONE	NH
EPA 8260 C 2006	4-CHLOROTOLUENE	NH	EPA 8260 C 2006	4-ISOPROPYLTOLUENE (P-CYME)	NH
EPA 8260 C 2006	4-METHYL-2-PENTANONE (MIBK)	NH	EPA 8260 C 2006	ACETONE	NH
EPA 8260 C 2006	ACETONITRILE	NH	EPA 8260 C 2006	ACROLEIN (PROPENAL)	NH
EPA 8260 C 2006	ACRYLONITRILE	NH	EPA 8260 C 2006	ALLYL CHLORIDE (3-CHLOROPROPENE)	NH
EPA 8260 C 2006	BENZENE	NH	EPA 8260 C 2006	BROMOBENZENE	NH
EPA 8260 C 2006	BROMOCHLOROMETHANE	NH	EPA 8260 C 2006	BROMODICHLOROMETHANE	NH
EPA 8260 C 2006	BROMOFORM	NH	EPA 8260 C 2006	CARBON DISULFIDE	NH
EPA 8260 C 2006	CARBON TETRACHLORIDE	NH	EPA 8260 C 2006	CHLOROBENZENE	NH
EPA 8260 C 2006	CHLORODIBROMOMETHANE	NH	EPA 8260 C 2006	CHLOROETHANE (ETHYL CHLORIDE)	NH
EPA 8260 C 2006	CHLOROFORM	NH	EPA 8260 C 2006	CIS-1,2-DICHLOROETHYLENE	NH
EPA 8260 C 2006	CIS-1,3-DICHLOROPROPENE	NH	EPA 8260 C 2006	DIBROMOMETHANE (METHYLENE BROMIDE)	NH
EPA 8260 C 2006	DICHLORODIFLUOROMETHANE (FREON-12)	NH	EPA 8260 C 2006	DIETHYL ETHER	NH
EPA 8260 C 2006	ETHYL METHACRYLATE	NH			

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EPA 8260 C 2006	ETHYL-T-BUTYLETHER (2-ETHOXY-2-METHYLPROPANE, ETBE)	NH	EPA 8260 C 2006	ETHYLBENZENE	NH
EPA 8260 C 2006	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH	EPA 8260 C 2006	IODOMETHANE (METHYL IODIDE)	NH
EPA 8260 C 2006	ISOBUTYL ALCOHOL (2-METHYL-1-PROPANOL)	NH	EPA 8260 C 2006	ISOPROPYLBENZENE	NH
EPA 8260 C 2006	METHACRYLONITRILE	NH	EPA 8260 C 2006	METHYL BROMIDE (BROMOMETHANE)	NH
EPA 8260 C 2006	METHYL CHLORIDE (CHLOROMETHANE)	NH	EPA 8260 C 2006	METHYL METHACRYLATE	NH
EPA 8260 C 2006	METHYL TERT-BUTYL ETHER (MTBE)	NH	EPA 8260 C 2006	METHYLCYCLOHEXANE	NH
EPA 8260 C 2006	METHYLENE CHLORIDE (DICHLOROMETHANE)	NH	EPA 8260 C 2006	N-BUTYLBENZENE	NH
EPA 8260 C 2006	N-PROPYLBENZENE	NH	EPA 8260 C 2006	NAPHTHALENE	NH
EPA 8260 C 2006	PENTACHLOROETHANE	NH	EPA 8260 C 2006	PROPIONITRILE (ETHYL CYANIDE)	NH
EPA 8260 C 2006	SEC-BUTYLBENZENE	NH	EPA 8260 C 2006	STYRENE	NH
EPA 8260 C 2006	T-AMYLMETHYLETHER (TAME)	NH	EPA 8260 C 2006	TERT-BUTYL ALCOHOL	NH
EPA 8260 C 2006	TERT-BUTYLBENZENE	NH	EPA 8260 C 2006	TETRACHLOROETHENE (PERCHLOROETHENE)	NH
EPA 8260 C 2006	TOLUENE	NH	EPA 8260 C 2006	TRANS-1,2-DICHLOROETHENE	NH
EPA 8260 C 2006	TRANS-1,3-DICHLOROPROPENE	NH	EPA 8260 C 2006	TRANS-1,4-DICHLORO-2-BUTENE	NH
EPA 8260 C 2006	TRICHLOROETHENE (TRICHLOROETHYLENE)	NH	EPA 8260 C 2006	TRICHLOROFLUOROMETHANE (FLUOROTRICHLOROMETHANE, FREON 11)	NH
EPA 8260 C 2006	VINYL ACETATE	NH	EPA 8260 C 2006	VINYL CHLORIDE	NH
EPA 8260 C 2006	XYLENE (TOTAL)	NH	EPA 8260 C - EXTENDED 2006	1,1,2-TRICHLORO-1,2,2-TRIFLUOR OETHANE (FREON 113)	NH
EPA 8260 C - EXTENDED 2006	DI-ISOPROPYLETHER (DIPE, ISOPROPYL ETHER)	NH	EPA 8270 C 1996	1,2,4,5-TETRACHLOROBENZENE	NH
EPA 8270 C 1996	1,2,4-TRICHLOROBENZENE	NH	EPA 8270 C 1996	1,2-DICHLOROBENZENE	NH
EPA 8270 C 1996	1,2-DIPHENYLHYDRAZINE	NH	EPA 8270 C 1996	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH
EPA 8270 C 1996	1,3-DICHLOROBENZENE	NH	EPA 8270 C 1996	1,3-DINITROBENZENE (1,3-DNB)	NH
EPA 8270 C 1996	1,4-DICHLOROBENZENE	NH	EPA 8270 C 1996	1,4-NAPHTHOQUINONE	NH
EPA 8270 C 1996	1,4-PHENYLENEDIAMINE	NH	EPA 8270 C 1996	2,4,5-TRICHLOROPHENOL	NH
EPA 8270 C 1996	2,4,6-TRICHLOROPHENOL	NH	EPA 8270 C 1996	2,4-DICHLOROPHENOL	NH
EPA 8270 C 1996	2,4-DIMETHYLPHENOL	NH	EPA 8270 C 1996	2,4-DINITROPHENOL	NH
EPA 8270 C 1996	2,4-DINITROTOLUENE (2,4-DNT)	NH	EPA 8270 C 1996	2,6-DICHLOROPHENOL	NH
EPA 8270 C 1996	2,6-DINITROTOLUENE (2,6-DNT)	NH	EPA 8270 C 1996	2-CHLORONAPHTHALENE	NH
EPA 8270 C 1996	2-CHLOROPHENOL	NH	EPA 8270 C 1996	2-METHYL-4,6-DINITROPHENOL (4,6-DINITRO-2-METHYLPHENOL)	NH
EPA 8270 C 1996	2-METHYLNAPHTHALENE	NH	EPA 8270 C 1996	2-METHYLPHENOL (O-CRESOL)	NH
EPA 8270 C 1996	2-NAPHTHYLAMINE	NH	EPA 8270 C 1996	2-NITROANILINE	NH

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EPA 8270 C 1996	2-NITROPHENOL	NH	EPA 8270 C 1996	2-PICOLINE (2-METHYLPYRIDINE)	NH
EPA 8270 C 1996	3,3'-DICHLOROBENZIDINE	NH	EPA 8270 C 1996	3,3'-DIMETHYLBENZIDINE	NH
EPA 8270 C 1996	3-METHYLCHOLANTHRENE	NH	EPA 8270 C 1996	3-NITROANILINE	NH
EPA 8270 C 1996	4-AMINOBIIPHENYL	NH	EPA 8270 C 1996	4-BROMOPHENYL PHENYL ETHER	NH
EPA 8270 C 1996	4-CHLORO-3-METHYLPHENOL	NH	EPA 8270 C 1996	4-CHLOROANILINE	NH
EPA 8270 C 1996	4-CHLOROPHENYL PHENYLETHER	NH	EPA 8270 C 1996	4-DIMETHYL AMINOAZOBENZENE	NH
EPA 8270 C 1996	4-METHYLPHENOL (P-CRESOL)	NH	EPA 8270 C 1996	4-NITROANILINE	NH
EPA 8270 C 1996	4-NITROPHENOL	NH	EPA 8270 C 1996	5-NITRO-O-TOLUIDINE	NH
EPA 8270 C 1996	7,12-DIMETHYLBENZ(A) ANTHRACENE	NH	EPA 8270 C 1996	ACENAPHTHENE	NH
EPA 8270 C 1996	ACENAPHTHYLENE	NH	EPA 8270 C 1996	ACETOPHENONE	NH
EPA 8270 C 1996	ANILINE	NH	EPA 8270 C 1996	ANTHRACENE	NH
EPA 8270 C 1996	ARAMITE	NH	EPA 8270 C 1996	BENZIDINE	NH
EPA 8270 C 1996	BENZO(A)ANTHRACENE	NH	EPA 8270 C 1996	BENZO(A)PYRENE	NH
EPA 8270 C 1996	BENZO(G,H,I)PERYLENE	NH	EPA 8270 C 1996	BENZO(K)FLUORANTHENE	NH
EPA 8270 C 1996	BENZO(B)FLUORANTHENE	NH	EPA 8270 C 1996	BENZYL ALCOHOL	NH
EPA 8270 C 1996	BIS(2-CHLOROETHOXY)METHANE	NH	EPA 8270 C 1996	BIS(2-CHLOROETHYL) ETHER	NH
EPA 8270 C 1996	BIS(2-CHLOROISOPROPYL) ETHER	NH	EPA 8270 C 1996	BIS(2-ETHYLHEXYL) PHTHALATE (DI(2-ETHYLHEXYL)PHTHALATE), (DEHP)	NH
EPA 8270 C 1996	BUTYL BENZYL PHTHALATE	NH	EPA 8270 C 1996	CHLOROBENZILATE	NH
EPA 8270 C 1996	CHRYSENE	NH	EPA 8270 C 1996	DI-N-BUTYL PHTHALATE	NH
EPA 8270 C 1996	DI-N-OCTYL PHTHALATE	NH	EPA 8270 C 1996	DIALLATE	NH
EPA 8270 C 1996	DIBENZO(A,H) ANTHRACENE	NH	EPA 8270 C 1996	DIBENZOFURAN	NH
EPA 8270 C 1996	DIETHYL PHTHALATE	NH	EPA 8270 C 1996	DIMETHOATE	NH
EPA 8270 C 1996	DIMETHYL PHTHALATE	NH	EPA 8270 C 1996	DINOSEB (2-SEC-BUTYL-4,6-DINITROPHENO L, DNBP)	NH
EPA 8270 C 1996	ETHYL METHANESULFONATE	NH	EPA 8270 C 1996	FAMPHUR	NH
EPA 8270 C 1996	FLUORANTHENE	NH	EPA 8270 C 1996	FLUORENE	NH
EPA 8270 C 1996	HEXACHLOROBENZENE	NH	EPA 8270 C 1996	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH
EPA 8270 C 1996	HEXACHLOROCYCLOPENTADIEN E	NH	EPA 8270 C 1996	HEXACHLOROETHANE	NH
EPA 8270 C 1996	HEXACHLOROPROPENE	NH	EPA 8270 C 1996	INDENO(1,2,3-CD) PYRENE	NH
EPA 8270 C 1996	ISODRIN	NH	EPA 8270 C 1996	ISOPHORONE	NH
EPA 8270 C 1996	ISOSAFROLE	NH	EPA 8270 C 1996	KEPONE	NH
EPA 8270 C 1996	METHYL METHANESULFONATE	NH	EPA 8270 C 1996	METHYL PARATHION (PARATHION, METHYL)	NH
EPA 8270 C 1996	N-NITROSO-DI-N-BUTYLAMINE	NH	EPA 8270 C 1996	N-NITROSODI-N-PROPYLAMINE	NH
EPA 8270 C 1996	N-NITROSODIETHYLAMINE	NH	EPA 8270 C 1996	N-NITROSODIMETHYLAMINE	NH

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EPA 8270 C 1996	N-NITROSODIPHENYLAMINE	NH
EPA 8270 C 1996	N-NITROSOMORPHOLINE	NH
EPA 8270 C 1996	N-NITROSOPYRROLIDINE	NH
EPA 8270 C 1996	NITROBENZENE	NH
EPA 8270 C 1996	O,O,O-TRIETHYL PHOSPHOROTHIOATE	NH
EPA 8270 C 1996	PENTACHLOROBENZENE	NH
EPA 8270 C 1996	PHENACETIN	NH
EPA 8270 C 1996	PHENOL	NH
EPA 8270 C 1996	PRONAMIDE (KERB)	NH
EPA 8270 C 1996	SAFROLE	NH
EPA 8270 C 1996	THIONAZIN (ZINOPHOS)	NH
EPA 8270 C SIM 1996	ACENAPHTHYLENE	NH
EPA 8270 C SIM 1996	BENZO(A)ANTHRACENE	NH
EPA 8270 C SIM 1996	BENZO(G,H,I)PERYLENE	NH
EPA 8270 C SIM 1996	BENZO[B]FLUORANTHENE	NH
EPA 8270 C SIM 1996	DIBENZO(A,H) ANTHRACENE	NH
EPA 8270 C SIM 1996	FLUORENE	NH
EPA 8270 C SIM 1996	NAPHTHALENE	NH
EPA 8270 C SIM 1996	PYRENE	NH
EPA 8270 D (2/07)	1,2,4-TRICHLOROBENZENE	NH
EPA 8270 D (2/07)	1,2-DIPHENYLHYDRAZINE	NH
EPA 8270 D (2/07)	1,3-DICHLOROBENZENE	NH
EPA 8270 D (2/07)	1,4-DICHLOROBENZENE	NH
EPA 8270 D (2/07)	1,4-PHENYLENEDIAMINE	NH
EPA 8270 D (2/07)	2,4,5-TRICHLOROPHENOL	NH
EPA 8270 D (2/07)	2,4-DICHLOROPHENOL	NH
EPA 8270 D (2/07)	2,4-DINITROPHENOL	NH
EPA 8270 D (2/07)	2,6-DICHLOROPHENOL	NH
EPA 8270 D (2/07)	2-ACETYLAMINOFLUORENE	NH
EPA 8270 D (2/07)	2-CHLOROPHENOL	NH
EPA 8270 D (2/07)	2-METHYLNAPHTHALENE	NH
EPA 8270 D (2/07)	2-NAPHTHYLAMINE	NH
EPA 8270 D (2/07)	2-NITROPHENOL	NH
EPA 8270 D (2/07)	3,3'-DICHLOROBENZIDINE	NH
EPA 8270 D (2/07)	3-METHYLCHOLANTHRENE	NH
EPA 8270 D (2/07)	4-AMINOBIPHENYL	NH

<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>
EPA 8270 C 1996	N-NITROSOMETHYLETHYLAMINE	NH
EPA 8270 C 1996	N-NITROSOPIPERIDINE	NH
EPA 8270 C 1996	NAPHTHALENE	NH
EPA 8270 C 1996	NITROQUINOLINE-1-OXIDE	NH
EPA 8270 C 1996	O-TOLUIDINE (2-METHYLANILINE)	NH
EPA 8270 C 1996	PENTACHLOROPHENOL	NH
EPA 8270 C 1996	PHENANTHRENE	NH
EPA 8270 C 1996	PHORATE	NH
EPA 8270 C 1996	PYRENE	NH
EPA 8270 C 1996	SULFOTEP (TETRAETHYL DITHIOPYROPHOSPHATE)	NH
EPA 8270 C SIM 1996	ACENAPHTHENE	NH
EPA 8270 C SIM 1996	ANTHRACENE	NH
EPA 8270 C SIM 1996	BENZO(A)PYRENE	NH
EPA 8270 C SIM 1996	BENZO(K)FLUORANTHENE	NH
EPA 8270 C SIM 1996	CHRYSENE	NH
EPA 8270 C SIM 1996	FLUORANTHENE	NH
EPA 8270 C SIM 1996	INDENO(1,2,3-CD) PYRENE	NH
EPA 8270 C SIM 1996	PHENANTHRENE	NH
EPA 8270 D (2/07)	1,2,4,5-TETRACHLOROBENZENE	NH
EPA 8270 D (2/07)	1,2-DICHLOROBENZENE	NH
EPA 8270 D (2/07)	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH
EPA 8270 D (2/07)	1,3-DINITROBENZENE (1,3-DNB)	NH
EPA 8270 D (2/07)	1,4-NAPHTHOQUINONE	NH
EPA 8270 D (2/07)	2,3,4,6-TETRACHLOROPHENOL	NH
EPA 8270 D (2/07)	2,4,6-TRICHLOROPHENOL	NH
EPA 8270 D (2/07)	2,4-DIMETHYLPHENOL	NH
EPA 8270 D (2/07)	2,4-DINITROTOLUENE (2,4-DNT)	NH
EPA 8270 D (2/07)	2,6-DINITROTOLUENE (2,6-DNT)	NH
EPA 8270 D (2/07)	2-CHLORONAPHTHALENE	NH
EPA 8270 D (2/07)	2-METHYL-4,6-DINITROPHENOL (4,6-DINITRO-2-METHYLPHENOL)	NH
EPA 8270 D (2/07)	2-METHYLPHENOL (O-CRESOL)	NH
EPA 8270 D (2/07)	2-NITROANILINE	NH
EPA 8270 D (2/07)	2-PICOLINE (2-METHYLPYRIDINE)	NH
EPA 8270 D (2/07)	3,3'-DIMETHYLBENZIDINE	NH
EPA 8270 D (2/07)	3-NITROANILINE	NH
EPA 8270 D (2/07)	4-BROMOPHENYL PHENYL ETHER	NH

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NON-POTABLE WATER

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EPA 8270 D (2/07)	4-CHLORO-3-METHYLPHENOL	NH	EPA 8270 D (2/07)	4-CHLOROANILINE	NH
EPA 8270 D (2/07)	4-CHLOROPHENYL PHENYLETHER	NH	EPA 8270 D (2/07)	4-DIMETHYL AMINOAZOBENZENE	NH
EPA 8270 D (2/07)	4-METHYLPHENOL (P-CRESOL)	NH	EPA 8270 D (2/07)	4-NITROANILINE	NH
EPA 8270 D (2/07)	4-NITROPHENOL	NH	EPA 8270 D (2/07)	5-NITRO-O-TOLUIDINE	NH
EPA 8270 D (2/07)	7,12-DIMETHYLBENZ(A) ANTHRACENE	NH	EPA 8270 D (2/07)	ACENAPHTHENE	NH
EPA 8270 D (2/07)	ACENAPHTHYLENE	NH	EPA 8270 D (2/07)	ACETOPHENONE	NH
EPA 8270 D (2/07)	ANILINE	NH	EPA 8270 D (2/07)	ANTHRACENE	NH
EPA 8270 D (2/07)	ARAMITE	NH	EPA 8270 D (2/07)	BENZIDINE	NH
EPA 8270 D (2/07)	BENZO(A)ANTHRACENE	NH	EPA 8270 D (2/07)	BENZO(A)PYRENE	NH
EPA 8270 D (2/07)	BENZO(G,H,I)PERYLENE	NH	EPA 8270 D (2/07)	BENZO(K)FLUORANTHENE	NH
EPA 8270 D (2/07)	BENZOIC ACID	NH	EPA 8270 D (2/07)	BENZO[B]FLUORANTHENE	NH
EPA 8270 D (2/07)	BENZYL ALCOHOL	NH	EPA 8270 D (2/07)	BIS(2-CHLOROETHOXY)METHANE	NH
EPA 8270 D (2/07)	BIS(2-CHLOROETHYL) ETHER	NH	EPA 8270 D (2/07)	BIS(2-CHLOROISOPROPYL) ETHER	NH
EPA 8270 D (2/07)	BIS(2-ETHYLHEXYL) PHTHALATE (DI(2-ETHYLHEXYL)PHTHALATE), (DEHP)	NH	EPA 8270 D (2/07)	BUTYL BENZYL PHTHALATE	NH
EPA 8270 D (2/07)	CHLOROBENZILATE	NH	EPA 8270 D (2/07)	CHRYSENE	NH
EPA 8270 D (2/07)	DI-N-BUTYL PHTHALATE	NH	EPA 8270 D (2/07)	DI-N-OCTYL PHTHALATE	NH
EPA 8270 D (2/07)	DIALATE	NH	EPA 8270 D (2/07)	DIBENZO(A,H) ANTHRACENE	NH
EPA 8270 D (2/07)	DIBENZOFURAN	NH	EPA 8270 D (2/07)	DIETHYL PHTHALATE	NH
EPA 8270 D (2/07)	DIMETHOATE	NH	EPA 8270 D (2/07)	DIMETHYL PHTHALATE	NH
EPA 8270 D (2/07)	DINOSEB (2-SEC-BUTYL-4,6-DINITROPHENO L, DNBP)	NH	EPA 8270 D (2/07)	ETHYL METHANESULFONATE	NH
EPA 8270 D (2/07)	FAMPHUR	NH	EPA 8270 D (2/07)	FLUORANTHENE	NH
EPA 8270 D (2/07)	FLUORENE	NH	EPA 8270 D (2/07)	HEXACHLOROBENZENE	NH
EPA 8270 D (2/07)	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH	EPA 8270 D (2/07)	HEXACHLOROCYCLOPENTADIEN E	NH
EPA 8270 D (2/07)	HEXACHLOROETHANE	NH	EPA 8270 D (2/07)	HEXACHLOROPROPENE	NH
EPA 8270 D (2/07)	INDENO(1,2,3-CD) PYRENE	NH	EPA 8270 D (2/07)	ISODRIN	NH
EPA 8270 D (2/07)	ISOPHORONE	NH	EPA 8270 D (2/07)	ISOSAFROLE	NH
EPA 8270 D (2/07)	KEPONE	NH	EPA 8270 D (2/07)	METHYL METHANESULFONATE	NH
EPA 8270 D (2/07)	METHYL PARATHION (PARATHION, METHYL)	NH	EPA 8270 D (2/07)	N-NITROSO-DI-N-BUTYLAMINE	NH
EPA 8270 D (2/07)	N-NITROSODI-N-PROPYLAMINE	NH	EPA 8270 D (2/07)	N-NITROSODIETHYLAMINE	NH
EPA 8270 D (2/07)	N-NITROSODIMETHYLAMINE	NH	EPA 8270 D (2/07)	N-NITROSODIPHENYLAMINE	NH
EPA 8270 D (2/07)	N-NITROSOMETHYLETHYLAMINE	NH	EPA 8270 D (2/07)	N-NITROSOMORPHOLINE	NH
EPA 8270 D (2/07)	N-NITROSOPIPERIDINE	NH	EPA 8270 D (2/07)	N-NITROSOPYRROLIDINE	NH
EPA 8270 D (2/07)	NAPHTHALENE	NH	EPA 8270 D (2/07)	NITROBENZENE	NH
EPA 8270 D (2/07)	NITROQUINOLINE-1-OXIDE	NH			

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EPA 8270 D (2/07)	O,O,O-TRIETHYL PHOSPHOROTHIOATE	NH	EPA 8270 D (2/07)	O-TOLUIDINE (2-METHYLANILINE)	NH
EPA 8270 D (2/07)	PENTACHLOROBENZENE	NH	EPA 8270 D (2/07)	PENTACHLORONITROBENZENE	NH
EPA 8270 D (2/07)	PENTACHLOROPHENOL	NH	EPA 8270 D (2/07)	PHENACETIN	NH
EPA 8270 D (2/07)	PHENANTHRENE	NH	EPA 8270 D (2/07)	PHENOL	NH
EPA 8270 D (2/07)	PHORATE	NH	EPA 8270 D (2/07)	PRONAMIDE (KERB)	NH
EPA 8270 D (2/07)	PYRENE	NH	EPA 8270 D (2/07)	SAFROLE	NH
EPA 8270 D (2/07)	SULFOTEPP (TETRAETHYL DITHIOPYROPHOSPHATE)	NH	EPA 8270 D (2/07)	THIONAZIN (ZINOPHOS)	NH
EPA 8270 D - EXTENDED (2/07)	1,1-BIPHENYL	NH	EPA 8270 D - EXTENDED (2/07)	CAPROLACTAM	NH
EPA 8270 D - EXTENDED (2/07)	CARBAZOLE	NH	EPA 8330 (9/94)	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH
EPA 8330 (9/94)	1,3-DINITROBENZENE (1,3-DNB)	NH	EPA 8330 (9/94)	2,4,6-TRINITROTOLUENE (2,4,6-TNT)	NH
EPA 8330 (9/94)	2,4-DINITROTOLUENE (2,4-DNT)	NH	EPA 8330 (9/94)	2,6-DINITROTOLUENE (2,6-DNT)	NH
EPA 8330 (9/94)	2-AMINO-4,6-DINITROTOLUENE (2-AM-DNT)	NH	EPA 8330 (9/94)	2-NITROTOLUENE	NH
EPA 8330 (9/94)	3-NITROTOLUENE	NH	EPA 8330 (9/94)	4-AMINO-2,6-DINITROTOLUENE (4-AM-DNT)	NH
EPA 8330 (9/94)	4-NITROTOLUENE	NH	EPA 8330 (9/94)	METHYL-2,4,6-TRINITROPHENYL N ITRAMINE (TETRYL)	NH
EPA 8330 (9/94)	NITROBENZENE	NH	EPA 8330 (9/94)	NITROGLYCERIN	NH
EPA 8330 (9/94)	OCTAHYDRO-1,3,5,7-TETRANITRO -1,3,5,7-TETRAZOCINE (HMX)	NH	EPA 8330 (9/94)	RDX (HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE)	NH
EPA 8330 B (10/06)	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH	EPA 8330 B (10/06)	1,3-DINITROBENZENE (1,3-DNB)	NH
EPA 8330 B (10/06)	2,4,6-TRINITROTOLUENE (2,4,6-TNT)	NH	EPA 8330 B (10/06)	2,4-DINITROTOLUENE (2,4-DNT)	NH
EPA 8330 B (10/06)	2,6-DINITROTOLUENE (2,6-DNT)	NH	EPA 8330 B (10/06)	2-AMINO-4,6-DINITROTOLUENE (2-AM-DNT)	NH
EPA 8330 B (10/06)	2-NITROTOLUENE	NH	EPA 8330 B (10/06)	3-NITROTOLUENE	NH
EPA 8330 B (10/06)	4-AMINO-2,6-DINITROTOLUENE (4-AM-DNT)	NH	EPA 8330 B (10/06)	4-NITROTOLUENE	NH
EPA 8330 B (10/06)	METHYL-2,4,6-TRINITROPHENYL N ITRAMINE (TETRYL)	NH	EPA 8330 B (10/06)	NITROBENZENE	NH
EPA 8330 B (10/06)	NITROGLYCERIN	NH	EPA 8330 B (10/06)	OCTAHYDRO-1,3,5,7-TETRANITRO -1,3,5,7-TETRAZOCINE (HMX)	NH
EPA 8330 B (10/06)	RDX (HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE)	NH	EPA 9038 1986	SULFATE	NH
EPA 9040 C (11/04)	PH	NH	EPA 9056 (9/94)	BROMIDE	NH
EPA 9056 (9/94)	CHLORIDE	NH	EPA 9056 (9/94)	NITRATE AS N	NH
EPA 9056 (9/94)	NITRITE	NH	EPA 9056 (9/94)	ORTHOPHOSPHATE AS P	NH
EPA 9056 (9/94)	SULFATE	NH	EPA 9056 A 2/07	ORTHOPHOSPHATE AS P	NH
EPA 9065 1986	TOTAL PHENOLICS	NH	EPA 9251 (9/86)	CHLORIDE	NH

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SM 2120 B 1995 21st ED	COLOR	NH	SM 2310 B 1998 20th ED	ACIDITY, AS CaCO ₃	NH
SM 2320 B 1998 21st ED	ALKALINITY AS CaCO ₃	NH	SM 2340 B-1997 1997	TOTAL HARDNESS AS CaCO ₃	NH
SM 2510 B 2005 21st ED	CONDUCTIVITY	NH	SM 2540 B 2005 21st ED	RESIDUE-TOTAL	NH
SM 2540 C 2005 21st ED	RESIDUE-FILTERABLE (TDS)	NH	SM 2540 D 2005 21st ED	RESIDUE-NONFILTERABLE (TSS)	NH
SM 2540 F 1998 20th ED	RESIDUE-SETTLABLE	NH	SM 3500-CR D 1995 19th ED	CHROMIUM VI	NH
SM 4500-CL ⁻ E 2005 21st ED	CHLORIDE	NH	SM 4500-F ⁻ C 2005 21st ED	FLUORIDE	NH
SM 4500-NH ₃ H 1992 18th ED	AMMONIA AS N	NH	SM 4500-NO ₃ ⁻ F 2005 21st	NITRATE/NITRITE	NH
SM 4500-NO ₃ ⁻ F 2005 21st	NITRITE AS N	NH	SM 4500-P E 1998 20th ED	ORTHOPHOSPHATE AS P	NH
SM 4500-S ₂ ⁻ E 1992 18th ED	SULFIDE	NH	SM 4500-SO ₃ ⁻ B 2005 21st ED	SULFITE-SO ₃	NH
SM 5210 B 2005 21st ED	CARBONACEOUS BOD, CBOD	NH	SM 5210 B-2001 2001	CARBONACEOUS BOD, CBOD	NH
SM 5310 B 2005 21st ED	TOTAL ORGANIC CARBON	NH	SM 5540 C 2005 21st ED	SURFACTANTS - MBAS	NH

SOLID AND CHEMICAL MATERIALS

<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>	<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>
EPA 1010 A 2002	FLASHPOINT	NH	EPA 1311 1992	PREP: TOXICITY CHARACTERISTIC LEACHING PROCEDURE	NH
EPA 1312 1994	PREP: SYNTHETIC PRECIPITATION LEACHING PROCEDURE	NH	EPA 6010 C 2007	ALUMINUM	NH
EPA 6010 C 2007	ANTIMONY	NH	EPA 6010 C 2007	ARSENIC	NH
EPA 6010 C 2007	BARIUM	NH	EPA 6010 C 2007	BERYLLIUM	NH
EPA 6010 C 2007	BORON	NH	EPA 6010 C 2007	CADMIUM	NH
EPA 6010 C 2007	CALCIUM	NH	EPA 6010 C 2007	CHROMIUM	NH
EPA 6010 C 2007	COBALT	NH	EPA 6010 C 2007	COPPER	NH
EPA 6010 C 2007	IRON	NH	EPA 6010 C 2007	LEAD	NH
EPA 6010 C 2007	MAGNESIUM	NH	EPA 6010 C 2007	MANGANESE	NH
EPA 6010 C 2007	NICKEL	NH	EPA 6010 C 2007	POTASSIUM	NH
EPA 6010 C 2007	SELENIUM	NH	EPA 6010 C 2007	SILVER	NH
EPA 6010 C 2007	SODIUM	NH	EPA 6010 C 2007	STRONTIUM	NH
EPA 6010 C 2007	THALLIUM	NH	EPA 6010 C 2007	TIN	NH
EPA 6010 C 2007	TITANIUM	NH	EPA 6010 C 2007	VANADIUM	NH
EPA 6010 C 2007	ZINC	NH	EPA 6020 A (2/07)	ALUMINUM	NH
EPA 6020 A (2/07)	ANTIMONY	NH	EPA 6020 A (2/07)	ARSENIC	NH

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EPA 6020 A (2/07)	BARIUM	NH	EPA 6020 A (2/07)	BERYLLIUM	NH
EPA 6020 A (2/07)	CADMIUM	NH	EPA 6020 A (2/07)	CHROMIUM	NH
EPA 6020 A (2/07)	COPPER	NH	EPA 6020 A (2/07)	IRON	NH
EPA 6020 A (2/07)	LEAD	NH	EPA 6020 A (2/07)	MANGANESE	NH
EPA 6020 A (2/07)	NICKEL	NH	EPA 6020 A (2/07)	SELENIUM	NH
EPA 6020 A (2/07)	SILVER	NH	EPA 6020 A (2/07)	THALLIUM	NH
EPA 6020 A (2/07)	ZINC	NH	EPA 7471 A 1994	MERCURY	NH
EPA 8015 C 2000	DIESEL RANGE ORGANICS (DRO)	NH	EPA 8015 C 2000	GASOLINE RANGE ORGANICS (GRO)	NH
EPA 8081 B (2/07)	4,4'-DDD	NH	EPA 8081 B (2/07)	4,4'-DDE	NH
EPA 8081 B (2/07)	4,4'-DDT	NH	EPA 8081 B (2/07)	ALDRIN	NH
EPA 8081 B (2/07)	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEXANE)	NH	EPA 8081 B (2/07)	ALPHA-CHLORDANE [CIS-CHLORDANE]	NH
EPA 8081 B (2/07)	BETA-BHC (BETA-HEXACHLOROCYCLOHEXANE)	NH	EPA 8081 B (2/07)	CHLORDANE (TECH.)	NH
EPA 8081 B (2/07)	DELTA-BHC	NH	EPA 8081 B (2/07)	DIELDRIN	NH
EPA 8081 B (2/07)	ENDOSULFAN I	NH	EPA 8081 B (2/07)	ENDOSULFAN II	NH
EPA 8081 B (2/07)	ENDOSULFAN SULFATE	NH	EPA 8081 B (2/07)	ENDRIN	NH
EPA 8081 B (2/07)	ENDRIN ALDEHYDE	NH	EPA 8081 B (2/07)	ENDRIN KETONE	NH
EPA 8081 B (2/07)	GAMMA-BHC (LINDANE, GAMMA-HEXACHLOROCYCLOHEXANE)	NH	EPA 8081 B (2/07)	GAMMA-CHLORDANE [BETA-CHLORDANE, TRANS-CHLORDANE]	NH
EPA 8081 B (2/07)	HEPTACHLOR	NH	EPA 8081 B (2/07)	HEPTACHLOR EPOXIDE	NH
EPA 8081 B (2/07)	METHOXYCHLOR	NH	EPA 8081 B (2/07)	TOXAPHENE (CHLORINATED CAMPHENE)	NH
EPA 8082 A (2/07)	2,2',3,3',4,4',5,5',6-NONACHLOROBIPHENYL (BZ-206)	NH	EPA 8082 A (2/07)	2,2',3,3',4,4',5-HEPTACHLOROBIPHENYL (BZ-170)	NH
EPA 8082 A (2/07)	2,2',3,4',5,5',6-HEPTACHLOROBIPHENYL (BZ-187)	NH	EPA 8082 A (2/07)	2,2',3,4,4',5',6-HEPTACHLOROBIPHENYL (BZ-183)	NH
EPA 8082 A (2/07)	2,2',3,4,4',5'-HEXACHLOROBIPHENYL (BZ-138)	NH	EPA 8082 A (2/07)	2,2',3,4,5'-PENTACHLOROBIPHENYL (BZ-87)	NH
EPA 8082 A (2/07)	2,2',3,4,5,5'-HEXACHLOROBIPHENYL (BZ-141)	NH	EPA 8082 A (2/07)	2,2',3,5'-TETRACHLOROBIPHENYL (BZ-44)	NH
EPA 8082 A (2/07)	2,2',4,4',5,5'-HEXACHLOROBIPHENYL (BZ-153)	NH	EPA 8082 A (2/07)	2,2',4,5,5'-PENTACHLOROBIPHENYL (BZ-101)	NH
EPA 8082 A (2/07)	2,2',5,5'-TETRACHLOROBIPHENYL (BZ-52)	NH	EPA 8082 A (2/07)	2,2',5-TRICHLOROBIPHENYL (BZ-18)	NH
EPA 8082 A (2/07)	2,3,4,4'-TETRACHLOROBIPHENYL (BZ-66)	NH	EPA 8082 A (2/07)	AROCLOR-1016 (PCB-1016)	NH
EPA 8082 A (2/07)	AROCLOR-1221 (PCB-1221)	NH	EPA 8082 A (2/07)	AROCLOR-1232 (PCB-1232)	NH
EPA 8082 A (2/07)	AROCLOR-1242 (PCB-1242)	NH	EPA 8082 A (2/07)	AROCLOR-1248 (PCB-1248)	NH
EPA 8082 A (2/07)	AROCLOR-1254 (PCB-1254)	NH	EPA 8082 A (2/07)	AROCLOR-1260 (PCB-1260)	NH
EPA 8151 A (12/96)	2,4,5-T	NH	EPA 8151 A (12/96)	2,4-D	NH

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<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>	<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>
EPA 8151 A (12/96)	2,4-DB	NH	EPA 8151 A (12/96)	DALAPON	NH
EPA 8151 A (12/96)	DICAMBA	NH	EPA 8151 A (12/96)	DICHLOROPROP (DICHLORPROP)	NH
EPA 8151 A (12/96)	DINOSEB (2-SEC-BUTYL-4,6-DINITROPHENO L, DNBP)	NH	EPA 8151 A (12/96)	MCPA	NH
EPA 8151 A (12/96)	MCPD	NH	EPA 8151 A (12/96)	SILVEX (2,4,5-TP)	NH
EPA 8260 B 1996	1,1,1,2-TETRACHLOROETHANE	NH	EPA 8260 B 1996	1,1,1-TRICHLOROETHANE	NH
EPA 8260 B 1996	1,1,2,2-TETRACHLOROETHANE	NH	EPA 8260 B 1996	1,1,2-TRICHLOROETHANE	NH
EPA 8260 B 1996	1,1-DICHLOROETHANE	NH	EPA 8260 B 1996	1,1-DICHLOROETHYLENE	NH
EPA 8260 B 1996	1,1-DICHLOROPROPENE	NH	EPA 8260 B 1996	1,2,3-TRICHLOROBENZENE	NH
EPA 8260 B 1996	1,2,3-TRICHLOROPROPANE	NH	EPA 8260 B 1996	1,2,4-TRICHLOROBENZENE	NH
EPA 8260 B 1996	1,2,4-TRIMETHYLBENZENE	NH	EPA 8260 B 1996	1,2-DIBROMO-3-CHLOROPROPAN E (DBCP)	NH
EPA 8260 B 1996	1,2-DIBROMOETHANE (EDB, ETHYLENE DIBROMIDE)	NH	EPA 8260 B 1996	1,2-DICHLOROBENZENE	NH
EPA 8260 B 1996	1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	NH	EPA 8260 B 1996	1,2-DICHLOROPROPANE	NH
EPA 8260 B 1996	1,3,5-TRIMETHYLBENZENE	NH	EPA 8260 B 1996	1,3-DICHLOROBENZENE	NH
EPA 8260 B 1996	1,3-DICHLOROPROPANE	NH	EPA 8260 B 1996	1,4-DICHLOROBENZENE	NH
EPA 8260 B 1996	1,4-DIOXANE (1,4- DIETHYLENEOXIDE)	NH	EPA 8260 B 1996	2,2-DICHLOROPROPANE	NH
EPA 8260 B 1996	2-BUTANONE (METHYL ETHYL KETONE, MEK)	NH	EPA 8260 B 1996	2-CHLOROETHYL VINYL ETHER	NH
EPA 8260 B 1996	2-CHLOROTOLUENE	NH	EPA 8260 B 1996	2-HEXANONE	NH
EPA 8260 B 1996	4-ISOPROPYLTOLUENE (P-CYME)	NH	EPA 8260 B 1996	4-METHYL-2-PENTANONE (MIBK)	NH
EPA 8260 B 1996	ACETONE	NH	EPA 8260 B 1996	ACETONITRILE	NH
EPA 8260 B 1996	ACROLEIN (PROPENAL)	NH	EPA 8260 B 1996	ACRYLONITRILE	NH
EPA 8260 B 1996	ALLYL CHLORIDE (3-CHLOROPROPENE)	NH	EPA 8260 B 1996	BENZENE	NH
EPA 8260 B 1996	BROMOBENZENE	NH	EPA 8260 B 1996	BROMOCHLOROMETHANE	NH
EPA 8260 B 1996	BROMODICHLOROMETHANE	NH	EPA 8260 B 1996	BROMOFORM	NH
EPA 8260 B 1996	CARBON DISULFIDE	NH	EPA 8260 B 1996	CARBON TETRACHLORIDE	NH
EPA 8260 B 1996	CHLOROBENZENE	NH	EPA 8260 B 1996	CHLORODIBROMOMETHANE	NH
EPA 8260 B 1996	CHLOROETHANE (ETHYL CHLORIDE)	NH	EPA 8260 B 1996	CHLOROFORM	NH
EPA 8260 B 1996	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	NH	EPA 8260 B 1996	CIS-1,2-DICHLOROETHYLENE	NH
EPA 8260 B 1996	CIS-1,3-DICHLOROPROPENE	NH	EPA 8260 B 1996	DIBROMOMETHANE (METHYLENE BROMIDE)	NH
EPA 8260 B 1996	DICHLORODIFLUOROMETHANE (FREON-12)	NH	EPA 8260 B 1996	DIETHYL ETHER	NH
EPA 8260 B 1996	ETHYL METHACRYLATE	NH	EPA 8260 B 1996	ETHYLBENZENE	NH
EPA 8260 B 1996	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH	EPA 8260 B 1996	IODOMETHANE (METHYL IODIDE)	NH

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Scope of Accreditation

VELAP Certificate No.: 2457

KATAHDIN ANALYTICAL SERVICES, INC.
600 TECHNOLOGY WAY
SCARBOROUGH, ME 04074

Virginia Laboratory ID: 460179
Effective Date: September 15, 2013
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SOLID AND CHEMICAL MATERIALS

<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>	<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>
EPA 8260 B 1996	ISOBUTYL ALCOHOL (2-METHYL-1-PROPANOL)	NH	EPA 8260 B 1996	ISOPROPYL BENZENE	NH
EPA 8260 B 1996	METHACRYLONITRILE	NH	EPA 8260 B 1996	METHYL BROMIDE (BROMOMETHANE)	NH
EPA 8260 B 1996	METHYL CHLORIDE (CHLOROMETHANE)	NH	EPA 8260 B 1996	METHYL METHACRYLATE	NH
EPA 8260 B 1996	METHYL TERT-BUTYL ETHER (MTBE)	NH	EPA 8260 B 1996	METHYLENE CHLORIDE (DICHLOROMETHANE)	NH
EPA 8260 B 1996	N-BUTYL BENZENE	NH	EPA 8260 B 1996	N-PROPYL BENZENE	NH
EPA 8260 B 1996	NAPHTHALENE	NH	EPA 8260 B 1996	PENTACHLOROETHANE	NH
EPA 8260 B 1996	PROPIONITRILE (ETHYL CYANIDE)	NH	EPA 8260 B 1996	SEC-BUTYL BENZENE	NH
EPA 8260 B 1996	STYRENE	NH	EPA 8260 B 1996	TERT-BUTYL ALCOHOL	NH
EPA 8260 B 1996	TERT-BUTYL BENZENE	NH	EPA 8260 B 1996	TETRACHLOROETHENE (PERCHLOROETHENE)	NH
EPA 8260 B 1996	TOLUENE	NH	EPA 8260 B 1996	TRANS-1,2-DICHLOROETHENE	NH
EPA 8260 B 1996	TRANS-1,3-DICHLOROPROPENE	NH	EPA 8260 B 1996	TRANS-1,4-DICHLORO-2-BUTENE	NH
EPA 8260 B 1996	TRICHLOROETHENE (TRICHLOROETHYLENE)	NH	EPA 8260 B 1996	TRICHLOROFLUOROMETHANE (FLUOROTRICHLOROMETHANE, FREON 11)	NH
EPA 8260 B 1996	VINYL ACETATE	NH	EPA 8260 B 1996	VINYL CHLORIDE	NH
EPA 8260 B 1996	XYLENE (TOTAL)	NH	EPA 8260 B - EXTENDED 1996	DI-ISOPROPYLETHER (DIPE, ISOPROPYL ETHER)	NH
EPA 8260 B - EXTENDED 1996	ETHYL-T-BUTYLETHER (2-ETHOXY-2-METHYLPROPANE, ETBE)	NH	EPA 8260 B - EXTENDED 1996	T-AMYL METHYLETHER (TAME)	NH
EPA 8260 C 2006	1,1,1,2-TETRACHLOROETHANE	NH	EPA 8260 C 2006	1,1,1-TRICHLOROETHANE	NH
EPA 8260 C 2006	1,1,2,2-TETRACHLOROETHANE	NH	EPA 8260 C 2006	1,1,2-TRICHLOROETHANE	NH
EPA 8260 C 2006	1,1-DICHLOROETHANE	NH	EPA 8260 C 2006	1,1-DICHLOROETHYLENE	NH
EPA 8260 C 2006	1,1-DICHLOROPROPENE	NH	EPA 8260 C 2006	1,2,3-TRICHLOROBENZENE	NH
EPA 8260 C 2006	1,2,3-TRICHLOROPROPANE	NH	EPA 8260 C 2006	1,2,4-TRICHLOROBENZENE	NH
EPA 8260 C 2006	1,2,4-TRIMETHYLBENZENE	NH	EPA 8260 C 2006	1,2-DIBROMO-3-CHLOROPROPAN E (DBCP)	NH
EPA 8260 C 2006	1,2-DIBROMOETHANE (EDB, ETHYLENE DIBROMIDE)	NH	EPA 8260 C 2006	1,2-DICHLOROBENZENE	NH
EPA 8260 C 2006	1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	NH	EPA 8260 C 2006	1,2-DICHLOROPROPANE	NH
EPA 8260 C 2006	1,3,5-TRIMETHYLBENZENE	NH	EPA 8260 C 2006	1,3-DICHLOROBENZENE	NH
EPA 8260 C 2006	1,3-DICHLOROPROPANE	NH	EPA 8260 C 2006	1,4-DICHLOROBENZENE	NH
EPA 8260 C 2006	1,4-DIOXANE (1,4- DIETHYLENEOXIDE)	NH	EPA 8260 C 2006	2,2-DICHLOROPROPANE	NH
EPA 8260 C 2006	2-BUTANONE (METHYL ETHYL KETONE, MEK)	NH	EPA 8260 C 2006	2-CHLOROETHYL VINYL ETHER	NH
EPA 8260 C 2006	2-CHLOROTOLUENE	NH	EPA 8260 C 2006	2-HEXANONE	NH
EPA 8260 C 2006	4-ISOPROPYLTOLUENE (P-CYME)	NH	EPA 8260 C 2006	ACETONE	NH

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EPA 8260 C 2006	ACETONITRILE	NH	EPA 8260 C 2006	ACROLEIN (PROPENAL)	NH
EPA 8260 C 2006	ACRYLONITRILE	NH	EPA 8260 C 2006	BENZENE	NH
EPA 8260 C 2006	BROMOBENZENE	NH	EPA 8260 C 2006	BROMOCHLOROMETHANE	NH
EPA 8260 C 2006	BROMODICHLOROMETHANE	NH	EPA 8260 C 2006	BROMOFORM	NH
EPA 8260 C 2006	CARBON DISULFIDE	NH	EPA 8260 C 2006	CARBON TETRACHLORIDE	NH
EPA 8260 C 2006	CHLOROBENZENE	NH	EPA 8260 C 2006	CHLOROFORM	NH
EPA 8260 C 2006	CHLOROPRENE (2-CHLORO-1,3-BUTADIENE)	NH	EPA 8260 C 2006	CIS-1,2-DICHLOROETHYLENE	NH
EPA 8260 C 2006	CIS-1,3-DICHLOROPROPENE	NH	EPA 8260 C 2006	DIBROMOMETHANE (METHYLENE BROMIDE)	NH
EPA 8260 C 2006	DICHLORODIFLUOROMETHANE (FREON-12)	NH	EPA 8260 C 2006	ETHYL METHACRYLATE	NH
EPA 8260 C 2006	ETHYL-T-BUTYLETHER (2-ETHOXY-2-METHYLPROPANE, ETBE)	NH	EPA 8260 C 2006	ETHYLBENZENE	NH
EPA 8260 C 2006	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH	EPA 8260 C 2006	IODOMETHANE (METHYL IODIDE)	NH
EPA 8260 C 2006	ISOBUTYL ALCOHOL (2-METHYL-1-PROPANOL)	NH	EPA 8260 C 2006	ISOPROPYL ALCOHOL (2-PROPANOL, ISOPROPANOL)	NH
EPA 8260 C 2006	METHACRYLONITRILE	NH	EPA 8260 C 2006	METHYL BROMIDE (BROMOMETHANE)	NH
EPA 8260 C 2006	METHYL CHLORIDE (CHLOROMETHANE)	NH	EPA 8260 C 2006	METHYL METHACRYLATE	NH
EPA 8260 C 2006	METHYL TERT-BUTYL ETHER (MTBE)	NH	EPA 8260 C 2006	METHYLENE CHLORIDE (DICHLOROMETHANE)	NH
EPA 8260 C 2006	N-BUTYLBENZENE	NH	EPA 8260 C 2006	NAPHTHALENE	NH
EPA 8260 C 2006	PENTACHLOROETHANE	NH	EPA 8260 C 2006	PROPIONITRILE (ETHYL CYANIDE)	NH
EPA 8260 C 2006	PYRIDINE	NH	EPA 8260 C 2006	SEC-BUTYLBENZENE	NH
EPA 8260 C 2006	STYRENE	NH	EPA 8260 C 2006	TERT-BUTYL ALCOHOL	NH
EPA 8260 C 2006	TERT-BUTYLBENZENE	NH	EPA 8260 C 2006	TETRACHLOROETHENE (PERCHLOROETHENE)	NH
EPA 8260 C 2006	TOLUENE	NH	EPA 8260 C 2006	TRANS-1,2-DICHLOROETHENE	NH
EPA 8260 C 2006	TRANS-1,3-DICHLOROPROPENE	NH	EPA 8260 C 2006	TRICHLOROETHENE (TRICHLOROETHYLENE)	NH
EPA 8260 C 2006	TRICHLOROFLUOROMETHANE (FLUOROTRICHLOROMETHANE, FREON 11)	NH	EPA 8260 C 2006	VINYL ACETATE	NH
EPA 8260 C 2006	VINYL CHLORIDE	NH	EPA 8260 C 2006	XYLENE (TOTAL)	NH
EPA 8260 C - EXTENDED 2006	DI-ISOPROPYLETHER (DIPE, ISOPROPYL ETHER)	NH	EPA 8260 C - EXTENDED 2006	TETRAHYDROFURAN (THF)	NH
EPA 8270 C 1996	1,2,4-TRICHLOROBENZENE	NH	EPA 8270 C 1996	1,2-DICHLOROBENZENE	NH
EPA 8270 C 1996	1,2-DIPHENYLHYDRAZINE	NH	EPA 8270 C 1996	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH
EPA 8270 C 1996	1,3-DICHLOROBENZENE	NH	EPA 8270 C 1996	1,4-DICHLOROBENZENE	NH
EPA 8270 C 1996	1,4-NAPHTHOQUINONE	NH	EPA 8270 C 1996	1,4-PHENYLENEDIAMINE	NH

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EPA 8270 C 1996	1-NAPHTHYLAMINE	NH	EPA 8270 C 1996	2,3,4,6-TETRACHLOROPHENOL	NH
EPA 8270 C 1996	2,4,5-TRICHLOROPHENOL	NH	EPA 8270 C 1996	2,4,6-TRICHLOROPHENOL	NH
EPA 8270 C 1996	2,4-DICHLOROPHENOL	NH	EPA 8270 C 1996	2,4-DIMETHYLPHENOL	NH
EPA 8270 C 1996	2,4-DINITROPHENOL	NH	EPA 8270 C 1996	2,4-DINITROTOLUENE (2,4-DNT)	NH
EPA 8270 C 1996	2,6-DICHLOROPHENOL	NH	EPA 8270 C 1996	2,6-DINITROTOLUENE (2,6-DNT)	NH
EPA 8270 C 1996	2-ACETYLAMINOFLUORENE	NH	EPA 8270 C 1996	2-CHLORONAPHTHALENE	NH
EPA 8270 C 1996	2-CHLOROPHENOL	NH	EPA 8270 C 1996	2-METHYL-4,6-DINITROPHENOL (4,6-DINITRO-2-METHYLPHENOL)	NH
EPA 8270 C 1996	2-METHYLNAPHTHALENE	NH	EPA 8270 C 1996	2-METHYLPHENOL (O-CRESOL)	NH
EPA 8270 C 1996	2-NAPHTHYLAMINE	NH	EPA 8270 C 1996	2-NITROANILINE	NH
EPA 8270 C 1996	2-NITROPHENOL	NH	EPA 8270 C 1996	2-PICOLINE (2-METHYLPYRIDINE)	NH
EPA 8270 C 1996	3,3'-DICHLOROBENZIDINE	NH	EPA 8270 C 1996	3,3'-DIMETHYLBENZIDINE	NH
EPA 8270 C 1996	3-METHYLCHOLANTHRENE	NH	EPA 8270 C 1996	3-NITROANILINE	NH
EPA 8270 C 1996	4-AMINOBIIPHENYL	NH	EPA 8270 C 1996	4-BROMOPHENYL PHENYL ETHER	NH
EPA 8270 C 1996	4-CHLORO-3-METHYLPHENOL	NH	EPA 8270 C 1996	4-CHLOROANILINE	NH
EPA 8270 C 1996	4-CHLOROPHENYL PHENYLETHER	NH	EPA 8270 C 1996	4-DIMETHYL AMINOAZOBENZENE	NH
EPA 8270 C 1996	4-METHYLPHENOL (P-CRESOL)	NH	EPA 8270 C 1996	4-NITROANILINE	NH
EPA 8270 C 1996	4-NITROPHENOL	NH	EPA 8270 C 1996	5-NITRO-O-TOLUIDINE	NH
EPA 8270 C 1996	7,12-DIMETHYLBENZ(A) ANTHRACENE	NH	EPA 8270 C 1996	A-A-DIMETHYLPHENETHYLAMINE	NH
EPA 8270 C 1996	ACENAPHTHENE	NH	EPA 8270 C 1996	ACENAPHTHYLENE	NH
EPA 8270 C 1996	ACETOPHENONE	NH	EPA 8270 C 1996	ANILINE	NH
EPA 8270 C 1996	ANTHRACENE	NH	EPA 8270 C 1996	ARAMITE	NH
EPA 8270 C 1996	BENZIDINE	NH	EPA 8270 C 1996	BENZO(A)ANTHRACENE	NH
EPA 8270 C 1996	BENZO(A)PYRENE	NH	EPA 8270 C 1996	BENZO(G,H,I)PERYLENE	NH
EPA 8270 C 1996	BENZO(K)FLUORANTHENE	NH	EPA 8270 C 1996	BENZOIC ACID	NH
EPA 8270 C 1996	BENZO[B]FLUORANTHENE	NH	EPA 8270 C 1996	BENZYL ALCOHOL	NH
EPA 8270 C 1996	BIS(2-CHLOROETHOXY)METHANE	NH	EPA 8270 C 1996	BIS(2-CHLOROETHYL) ETHER	NH
EPA 8270 C 1996	BIS(2-CHLOROISOPROPYL) ETHER	NH	EPA 8270 C 1996	BIS(2-ETHYLHEXYL) PHTHALATE (DI(2-ETHYLHEXYL)PHTHALATE), (DEHP)	NH
EPA 8270 C 1996	BUTYL BENZYL PHTHALATE	NH	EPA 8270 C 1996	CHRYSENE	NH
EPA 8270 C 1996	DI-N-BUTYL PHTHALATE	NH	EPA 8270 C 1996	DI-N-OCTYL PHTHALATE	NH
EPA 8270 C 1996	DIALATE	NH	EPA 8270 C 1996	DIBENZO(A,H) ANTHRACENE	NH
EPA 8270 C 1996	DIBENZOFURAN	NH	EPA 8270 C 1996	DIETHYL PHTHALATE	NH
EPA 8270 C 1996	DIMETHOATE	NH	EPA 8270 C 1996	DIMETHYL PHTHALATE	NH
EPA 8270 C 1996	DINOSEB (2-SEC-BUTYL-4,6-DINITROPHENO L, DNBP)	NH	EPA 8270 C 1996	ETHYL METHANESULFONATE	NH
EPA 8270 C 1996	FAMPHUR	NH	EPA 8270 C 1996	FLUORANTHENE	NH

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EPA 8270 C 1996	FLUORENE	NH	EPA 8270 C 1996	HEXACHLOROBENZENE	NH
EPA 8270 C 1996	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH	EPA 8270 C 1996	HEXACHLOROCYCLOPENTADIENE	NH
EPA 8270 C 1996	HEXACHLOROETHANE	NH	EPA 8270 C 1996	HEXACHLOROPROPENE	NH
EPA 8270 C 1996	INDENO(1,2,3-CD) PYRENE	NH	EPA 8270 C 1996	ISODRIN	NH
EPA 8270 C 1996	ISOPHORONE	NH	EPA 8270 C 1996	ISOSAFROLE	NH
EPA 8270 C 1996	KEPONE	NH	EPA 8270 C 1996	METHAPYRILENE	NH
EPA 8270 C 1996	METHYL METHANESULFONATE	NH	EPA 8270 C 1996	METHYL PARATHION (PARATHION, METHYL)	NH
EPA 8270 C 1996	N-NITROSO-DI-N-BUTYLAMINE	NH	EPA 8270 C 1996	N-NITROSODI-N-PROPYLAMINE	NH
EPA 8270 C 1996	N-NITROSODIETHYLAMINE	NH	EPA 8270 C 1996	N-NITROSODIMETHYLAMINE	NH
EPA 8270 C 1996	N-NITROSOMETHYLETHYLAMINE	NH	EPA 8270 C 1996	N-NITROSOMORPHOLINE	NH
EPA 8270 C 1996	N-NITROSOPIPERIDINE	NH	EPA 8270 C 1996	N-NITROSOPYRROLIDINE	NH
EPA 8270 C 1996	NAPHTHALENE	NH	EPA 8270 C 1996	NITROBENZENE	NH
EPA 8270 C 1996	NITROQUINOLINE-1-OXIDE	NH	EPA 8270 C 1996	O,O,O-TRIETHYL PHOSPHOROTHIOATE	NH
EPA 8270 C 1996	O-TOLUIDINE (2-METHYLANILINE)	NH	EPA 8270 C 1996	PENTACHLOROBENZENE	NH
EPA 8270 C 1996	PENTACHLORONITROBENZENE	NH	EPA 8270 C 1996	PENTACHLOROPHENOL	NH
EPA 8270 C 1996	PHENACETIN	NH	EPA 8270 C 1996	PHENANTHRENE	NH
EPA 8270 C 1996	PHENOL	NH	EPA 8270 C 1996	PRONAMIDE (KERB)	NH
EPA 8270 C 1996	PYRENE	NH	EPA 8270 C 1996	SAFROLE	NH
EPA 8270 C 1996	SULFOTEPP (TETRAETHYL DITHIOPYROPHOSPHATE)	NH	EPA 8270 C 1996	THONAZIN (ZINOPHOS)	NH
EPA 8270 D (2/07)	1,2,4,5-TETRACHLOROBENZENE	NH	EPA 8270 D (2/07)	1,2,4-TRICHLOROBENZENE	NH
EPA 8270 D (2/07)	1,2-DICHLOROBENZENE	NH	EPA 8270 D (2/07)	1,2-DIPHENYLHYDRAZINE	NH
EPA 8270 D (2/07)	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH	EPA 8270 D (2/07)	1,3-DICHLOROBENZENE	NH
EPA 8270 D (2/07)	1,4-DICHLOROBENZENE	NH	EPA 8270 D (2/07)	1,4-NAPHTHOQUINONE	NH
EPA 8270 D (2/07)	1,4-PHENYLENEDIAMINE	NH	EPA 8270 D (2/07)	1-NAPHTHYLAMINE	NH
EPA 8270 D (2/07)	2,3,4,6-TETRACHLOROPHENOL	NH	EPA 8270 D (2/07)	2,4,5-TRICHLOROPHENOL	NH
EPA 8270 D (2/07)	2,4,6-TRICHLOROPHENOL	NH	EPA 8270 D (2/07)	2,4-DICHLOROPHENOL	NH
EPA 8270 D (2/07)	2,4-DIMETHYLPHENOL	NH	EPA 8270 D (2/07)	2,4-DINITROPHENOL	NH
EPA 8270 D (2/07)	2,4-DINITROTOLUENE (2,4-DNT)	NH	EPA 8270 D (2/07)	2,6-DICHLOROPHENOL	NH
EPA 8270 D (2/07)	2,6-DINITROTOLUENE (2,6-DNT)	NH	EPA 8270 D (2/07)	2-ACETYLAMINOFUORENE	NH
EPA 8270 D (2/07)	2-CHLORONAPHTHALENE	NH	EPA 8270 D (2/07)	2-CHLOROPHENOL	NH
EPA 8270 D (2/07)	2-METHYL-4,6-DINITROPHENOL (4,6-DINITRO-2-METHYLPHENOL)	NH	EPA 8270 D (2/07)	2-METHYLNAPHTHALENE	NH
EPA 8270 D (2/07)	2-METHYLPHENOL (O-CRESOL)	NH	EPA 8270 D (2/07)	2-NAPHTHYLAMINE	NH
EPA 8270 D (2/07)	2-NITROANILINE	NH	EPA 8270 D (2/07)	2-NITROPHENOL	NH
EPA 8270 D (2/07)	2-PICOLINE (2-METHYLPYRIDINE)	NH	EPA 8270 D (2/07)	3,3'-DICHLOROBENZIDINE	NH
EPA 8270 D (2/07)	3,3-DIMETHYLBENZIDINE	NH	EPA 8270 D (2/07)	3-METHYLCHOLANTHRENE	NH
EPA 8270 D (2/07)	3-NITROANILINE	NH	EPA 8270 D (2/07)	4-AMINOBIIPHENYL	NH



Commonwealth of Virginia
Department of General Services
Division of Consolidated Laboratory Services



Scope of Accreditation

VELAP Certificate No.: 2457

KATAHDIN ANALYTICAL SERVICES, INC.
600 TECHNOLOGY WAY
SCARBOROUGH, ME 04074

Virginia Laboratory ID: 460179
Effective Date: September 15, 2013
Expiration Date: September 14, 2014

SOLID AND CHEMICAL MATERIALS

<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>	<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>
EPA 8270 D (2/07)	4-BROMOPHENYL PHENYL ETHER	NH	EPA 8270 D (2/07)	4-CHLORO-3-METHYLPHENOL	NH
EPA 8270 D (2/07)	4-CHLOROANILINE	NH	EPA 8270 D (2/07)	4-CHLOROPHENYL PHENYLETHER	NH
EPA 8270 D (2/07)	4-DIMETHYL AMINOAZOBENZENE	NH	EPA 8270 D (2/07)	4-METHYLPHENOL (P-CRESOL)	NH
EPA 8270 D (2/07)	4-NITROANILINE	NH	EPA 8270 D (2/07)	4-NITROPHENOL	NH
EPA 8270 D (2/07)	5-NITRO-O-TOLUIDINE	NH	EPA 8270 D (2/07)	7,12-DIMETHYLBENZ(A) ANTHRACENE	NH
EPA 8270 D (2/07)	A-A-DIMETHYLPHENETHYLAMINE	NH	EPA 8270 D (2/07)	ACENAPHTHENE	NH
EPA 8270 D (2/07)	ACENAPHTHYLENE	NH	EPA 8270 D (2/07)	ACETOPHENONE	NH
EPA 8270 D (2/07)	ANILINE	NH	EPA 8270 D (2/07)	ANTHRACENE	NH
EPA 8270 D (2/07)	ARAMITE	NH	EPA 8270 D (2/07)	BENZIDINE	NH
EPA 8270 D (2/07)	BENZO(A)ANTHRACENE	NH	EPA 8270 D (2/07)	BENZO(A)PYRENE	NH
EPA 8270 D (2/07)	BENZO(G,H,I)PERYLENE	NH	EPA 8270 D (2/07)	BENZO(K)FLUORANTHENE	NH
EPA 8270 D (2/07)	BENZOIC ACID	NH	EPA 8270 D (2/07)	BENZO[B]FLUORANTHENE	NH
EPA 8270 D (2/07)	BENZYL ALCOHOL	NH	EPA 8270 D (2/07)	BIS(2-CHLOROETHOXY)METHANE	NH
EPA 8270 D (2/07)	BIS(2-CHLOROETHYL) ETHER	NH	EPA 8270 D (2/07)	BIS(2-CHLOROISOPROPYL) ETHER	NH
EPA 8270 D (2/07)	BIS(2-ETHYLHEXYL) PHTHALATE (DI(2-ETHYLHEXYL)PHTHALATE), (DEHP)	NH	EPA 8270 D (2/07)	BUTYL BENZYL PHTHALATE	NH
EPA 8270 D (2/07)	CHRYSENE	NH	EPA 8270 D (2/07)	DI-N-BUTYL PHTHALATE	NH
EPA 8270 D (2/07)	DI-N-OCTYL PHTHALATE	NH	EPA 8270 D (2/07)	DIALATE	NH
EPA 8270 D (2/07)	DIBENZO(A,H) ANTHRACENE	NH	EPA 8270 D (2/07)	DIBENZOFURAN	NH
EPA 8270 D (2/07)	DIETHYL PHTHALATE	NH	EPA 8270 D (2/07)	DIMETHOATE	NH
EPA 8270 D (2/07)	DIMETHYL PHTHALATE	NH	EPA 8270 D (2/07)	DINOSEB (2-SEC-BUTYL-4,6-DINITROPHENO L, DNBP)	NH
EPA 8270 D (2/07)	ETHYL METHANESULFONATE	NH	EPA 8270 D (2/07)	FAMPHUR	NH
EPA 8270 D (2/07)	FLUORANTHENE	NH	EPA 8270 D (2/07)	FLUORENE	NH
EPA 8270 D (2/07)	HEXACHLOROBENZENE	NH	EPA 8270 D (2/07)	HEXACHLOROBUTADIENE (1,3-HEXACHLOROBUTADIENE)	NH
EPA 8270 D (2/07)	HEXACHLOROCYCLOPENTADIEN E	NH	EPA 8270 D (2/07)	HEXACHLOROETHANE	NH
EPA 8270 D (2/07)	HEXACHLOROPROPENE	NH	EPA 8270 D (2/07)	INDENO(1,2,3-CD) PYRENE	NH
EPA 8270 D (2/07)	ISODRIN	NH	EPA 8270 D (2/07)	ISOPHORONE	NH
EPA 8270 D (2/07)	ISOSAFROLE	NH	EPA 8270 D (2/07)	KEPONE	NH
EPA 8270 D (2/07)	METHAPYRILENE	NH	EPA 8270 D (2/07)	METHYL METHANESULFONATE	NH
EPA 8270 D (2/07)	METHYL PARATHION (PARATHION, METHYL)	NH	EPA 8270 D (2/07)	N-NITROSO-DI-N-BUTYLAMINE	NH
EPA 8270 D (2/07)	N-NITROSODI-N-PROPYLAMINE	NH	EPA 8270 D (2/07)	N-NITROSODIETHYLAMINE	NH
EPA 8270 D (2/07)	N-NITROSODIMETHYLAMINE	NH	EPA 8270 D (2/07)	N-NITROSOMETHYLETHYLAMINE	NH
EPA 8270 D (2/07)	N-NITROSOMORPHOLINE	NH	EPA 8270 D (2/07)	N-NITROSOPIPERIDINE	NH
EPA 8270 D (2/07)	N-NITROSOPYRROLIDINE	NH	EPA 8270 D (2/07)	NAPHTHALENE	NH

This Scope of Accreditation must accompany the Certificate issued by Virginia DCLS with the same Certificate Number indicated above.



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SOLID AND CHEMICAL MATERIALS

<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>	<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>
EPA 8270 D (2/07)	NITROBENZENE	NH	EPA 8270 D (2/07)	NITROQUINOLINE-1-OXIDE	NH
EPA 8270 D (2/07)	O,O,O-TRIETHYL PHOSPHOROTHIOATE	NH	EPA 8270 D (2/07)	O-TOLUIDINE (2-METHYLANILINE)	NH
EPA 8270 D (2/07)	PENTACHLOROBENZENE	NH	EPA 8270 D (2/07)	PENTACHLORONITROBENZENE	NH
EPA 8270 D (2/07)	PENTACHLOROPHENOL	NH	EPA 8270 D (2/07)	PHENACETIN	NH
EPA 8270 D (2/07)	PHENANTHRENE	NH	EPA 8270 D (2/07)	PHENOL	NH
EPA 8270 D (2/07)	PHORATE	NH	EPA 8270 D (2/07)	PRONAMIDE (KERB)	NH
EPA 8270 D (2/07)	PYRENE	NH	EPA 8270 D (2/07)	SAFROLE	NH
EPA 8270 D (2/07)	SULFOTEP (TETRAETHYL DITHIOPYROPHOSPHATE)	NH	EPA 8270 D (2/07)	THIONAZIN (ZINOPHOS)	NH
EPA 8330 (9/94)	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH	EPA 8330 (9/94)	1,3-DINITROBENZENE (1,3-DNB)	NH
EPA 8330 (9/94)	2,4,6-TRINITROTOLUENE (2,4,6-TNT)	NH	EPA 8330 (9/94)	2,4-DINITROTOLUENE (2,4-DNT)	NH
EPA 8330 (9/94)	2,6-DINITROTOLUENE (2,6-DNT)	NH	EPA 8330 (9/94)	2-AMINO-4,6-DINITROTOLUENE (2-AM-DNT)	NH
EPA 8330 (9/94)	2-NITROTOLUENE	NH	EPA 8330 (9/94)	3-NITROTOLUENE	NH
EPA 8330 (9/94)	4-AMINO-2,6-DINITROTOLUENE (4-AM-DNT)	NH	EPA 8330 (9/94)	4-NITROTOLUENE	NH
EPA 8330 (9/94)	METHYL-2,4,6-TRINITROPHENYL N ITRAMINE (TETRYL)	NH	EPA 8330 (9/94)	NITROBENZENE	NH
EPA 8330 (9/94)	NITROGLYCERIN	NH	EPA 8330 (9/94)	OCTAHYDRO-1,3,5,7-TETRAZOCINE -1,3,5,7-TETRAZOCINE (HMX)	NH
EPA 8330 (9/94)	RDX (HEXAHYDRO-1,3,5-TRINITRO-1,3, 5-TRIAZINE)	NH	EPA 8330 B (10/06)	1,3,5-TRINITROBENZENE (1,3,5-TNB)	NH
EPA 8330 B (10/06)	1,3-DINITROBENZENE (1,3-DNB)	NH	EPA 8330 B (10/06)	2,4,6-TRINITROTOLUENE (2,4,6-TNT)	NH
EPA 8330 B (10/06)	2,4-DINITROTOLUENE (2,4-DNT)	NH	EPA 8330 B (10/06)	2,6-DINITROTOLUENE (2,6-DNT)	NH
EPA 8330 B (10/06)	2-AMINO-4,6-DINITROTOLUENE (2-AM-DNT)	NH	EPA 8330 B (10/06)	2-NITROTOLUENE	NH
EPA 8330 B (10/06)	3-NITROTOLUENE	NH	EPA 8330 B (10/06)	4-AMINO-2,6-DINITROTOLUENE (4-AM-DNT)	NH
EPA 8330 B (10/06)	4-NITROTOLUENE	NH	EPA 8330 B (10/06)	METHYL-2,4,6-TRINITROPHENYL N ITRAMINE (TETRYL)	NH
EPA 8330 B (10/06)	NITROBENZENE	NH	EPA 8330 B (10/06)	NITROGLYCERIN	NH
EPA 8330 B (10/06)	OCTAHYDRO-1,3,5,7-TETRAZOCINE -1,3,5,7-TETRAZOCINE (HMX)	NH	EPA 8330 B (10/06)	RDX (HEXAHYDRO-1,3,5-TRINITRO-1,3, 5-TRIAZINE)	NH
EPA 9038 1986	SULFATE	NH	EPA 9040 B (1/95)	PH	NH
EPA 9045 D 2004	PH	NH	EPA 9056 (9/94)	BROMIDE	NH
EPA 9056 (9/94)	CHLORIDE	NH	EPA 9056 (9/94)	NITRATE AS N	NH
EPA 9056 (9/94)	NITRITE	NH	EPA 9056 (9/94)	ORTHOPHOSPHATE AS P	NH
EPA 9056 (9/94)	SULFATE	NH	EPA 9056 A 2/07	ORTHOPHOSPHATE AS P	NH
EPA 9060 (9/86)	TOTAL ORGANIC CARBON	NH	EPA 9065 1986	TOTAL PHENOLICS	NH
EPA 9071 B (4/98)	OIL & GREASE	NH	EPA 9095 B 2004	FREE LIQUID	NH

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SOLID AND CHEMICAL MATERIALS

<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>	<u>METHOD</u>	<u>ANALYTE</u>	<u>PRIMARY</u>
EPA 9251 (9/86)	CHLORIDE	NH			



**LABORATORY
ACCREDITATION
BUREAU**



Certificate of Accreditation

ISO/IEC 17025:2005

Certificate Number L2340

EnviroSystems, Inc

1 Lafayette Rd
Hampton, NH 03842

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: November 28, 2015

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 28th of November 2012

*See the laboratory's Scope of Accreditation for details of accredited parameters

**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

Scope of Accreditation For EnviroSystems, Inc

1 Lafayette Rd
Hampton, NH 03842
Kenneth Simon
603-926-3345

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to **EnviroSystems, Inc** to perform the following tests:

Accreditation granted through: **November 28, 2015**

Testing - Environmental

Non-Potable Water		
Technology	Method	Analyte
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium

Non-Potable Water		
Technology	Method	Analyte
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
CVAF	EPA 245.7	Mercury
Colormetric	SM-3500 Cr D	Hexavalent Chromium
Colormetric	EPA 310.2	Alkalinity
Gravimetric	EPA 1664 A (HEM)	Oil and Grease
Gravimetric	EPA 1664 A (SGT-HEM)	Mineral Oil and Grease
Colormetric	SM-4500 NH ₃ G	Ammonia
Colormetric	SM-4500 NH ₃ G	Total Kjeldahl Nitrogen
Gravimetric	SM 2540 B	Residue, total (TS)
Gravimetric	SM 2540 C	Residue, filterable (TSS)
Gravimetric	SM 2540 D	Residue, non-filterable (TDS)
Titration	SM 4500 Cl C	Chloride
Distillation/Colormetric	SM 4500 CN E	Total Cyanide
Colormetric	SM 4500 NO ₃ F	Nitrate-Nitrite
Colormetric	SM 4500P E	Orthophosphate as P
Digestion/Colormetric	SM 4500 P	Total Phosphorus
Empirical	SM 5210 B	Biological Oxygen Demand
Empirical	SM 5210 B	Carbonaceous Oxygen Demand
Titration	SM 5220 C	Chemical Oxygen Demand
Combustion/IR	SM 5310 C	Total Organic Carbon
Gravimetric	SM 4500 SO ₄ E	Sulfate
GC-ECD	EPA 8082B	Arochlor 1016
GC-ECD	EPA 8082B	Arochlor 1221
GC-ECD	EPA 8082B	Arochlor 1232
GC-ECD	EPA 8082B	Arochlor 1242
GC-ECD	EPA 8082B	Arochlor 1248
GC-ECD	EPA 8082B	Arochlor 1254
GC-ECD	EPA 8082B	Arochlor 1260
GC-Mass Spectrometer	EPA 680 modified (SIM)	PCB Congeners
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,4'-dichlorobiphenyl (PCB 8)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',5'-trichlorobiphenyl (PCB 18)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,4,4'-trichlorobiphenyl (PCB 28)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,5'-tetrachlorobiphenyl (PCB 44)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,5'-tetrachlorobiphenyl (PCB 49)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',5,5'-tetrachlorobiphenyl (PCB 52)

Non-Potable Water		
Technology	Method	Analyte
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3',4,4'-tetrachlorobiphenyl (PCB 66)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,5'-pentachlorobiphenyl (PCB 87)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,5,5'-pentachlorobiphenyl (PCB 101)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3,3',4,4'-pentachlorobiphenyl (PCB 105)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3',4,4',5-pentachlorobiphenyl (PCB 118)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4'-hexachlorobiphenyl (PCB 128)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4'-hexachlorobiphenyl (PCB 128)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,4',5,5'-hexachlorobiphenyl (PCB 153)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5-heptachlorobiphenyl (PCB 170)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',5,5'-heptachlorobiphenyl (PCB 180)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',5,6-heptachlorobiphenyl (PCB 183)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',6,6'-heptachlorobiphenyl (PCB 184)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,5,5',6-heptachlorobiphenyl (PCB 187)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5,6-octachlorobiphenyl (PCB 195)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5,5',6-nonachlorobiphenyl (PCB 206)
GC-Mass Spectrometer	EPA 680 modified (SIM)	Decachlorobiphenyl (PCB 209)

Drinking Water		
Technology	Method	Analyte
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Thallium

Drinking Water		
Technology	Method	Analyte
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc

Solid and Chemical Materials		
Technology	Method	Analyte
ICP-MS	EPA 6020B	Aluminum
ICP-MS	EPA 6020B	Antimony
ICP-MS	EPA 6020B	Arsenic
ICP-MS	EPA 6020B	Barium
ICP-MS	EPA 6020B	Beryllium
ICP-MS	EPA 6020B	Boron
ICP-MS	EPA 6020B	Cadmium
ICP-MS	EPA 6020B	Calcium
ICP-MS	EPA 6020B	Chromium
ICP-MS	EPA 6020B	Cobalt
ICP-MS	EPA 6020B	Copper
ICP-MS	EPA 6020B	Iron
ICP-MS	EPA 6020B	Lead
ICP-MS	EPA 6020B	Magnesium
ICP-MS	EPA 6020B	Manganese
ICP-MS	EPA 6020B	Molybdenum
ICP-MS	EPA 6020B	Nickel
ICP-MS	EPA 6020B	Potassium
ICP-MS	EPA 6020B	Selenium
ICP-MS	EPA 6020B	Silver
ICP-MS	EPA 6020B	Sodium
ICP-MS	EPA 6020B	Thallium
ICP-MS	EPA 6020B	Vanadium
ICP-MS	EPA 6020B	Zinc
CVAF	EPA 245.7	Mercury
GC-ECD	EPA 8082B	Arochlor 1016
GC-ECD	EPA 8082B	Arochlor 1221
GC-ECD	EPA 8082B	Arochlor 1232
GC-ECD	EPA 8082B	Arochlor 1242
GC-ECD	EPA 8082B	Arochlor 1248
GC-ECD	EPA 8082B	Arochlor 1254
GC-ECD	EPA 8082B	Arochlor 1260

Solid and Chemical Materials		
Technology	Method	Analyte
GC-Mass Spectrometer	EPA 680 modified (SIM)	PCB Congeners
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,4'-dichlorobiphenyl (PCB 8)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',5'-trichlorobiphenyl (PCB 18)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,4,4'-trichlorobiphenyl (PCB 28)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,5'-tetrachlorobiphenyl (PCB 44)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,5'-tetrachlorobiphenyl (PCB 49)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',5,5'-tetrachlorobiphenyl (PCB 52)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3',4,4'-tetrachlorobiphenyl (PCB 66)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,5'-pentachlorobiphenyl (PCB 87)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,5,5'-pentachlorobiphenyl (PCB 101)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3,3',4,4'-pentachlorobiphenyl (PCB 105)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3',4,4',5'-pentachlorobiphenyl (PCB 118)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4'-hexachlorobiphenyl (PCB 128)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4'-hexachlorobiphenyl (PCB 128)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,4',5,5'-hexachlorobiphenyl (PCB 153)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5'-heptachlorobiphenyl (PCB 170)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',5,5'-heptachlorobiphenyl (PCB 180)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',5',6'-heptachlorobiphenyl (PCB 183)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',6,6'-heptachlorobiphenyl (PCB 184)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4',5,5',6'-heptachlorobiphenyl (PCB 187)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5,6'-octachlorobiphenyl (PCB 195)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5,5',6'-nonachlorobiphenyl (PCB 206)
GC-Mass Spectrometer	EPA 680 modified (SIM)	Decachlorobiphenyl (PCB 209)
Combustion/IR	EPA 9060	Total Organic Carbon
Preparation	Method	Type
Acid Digestion	EPA 3050B	

Biological Tissue		
Technology	Method	Analyte
ICP-MS	EPA 6020B	Aluminum
ICP-MS	EPA 6020B	Antimony
ICP-MS	EPA 6020B	Arsenic
ICP-MS	EPA 6020B	Barium
ICP-MS	EPA 6020B	Beryllium
ICP-MS	EPA 6020B	Boron
ICP-MS	EPA 6020B	Cadmium
ICP-MS	EPA 6020B	Calcium

Biological Tissue		
Technology	Method	Analyte
ICP-MS	EPA 6020B	Chromium
ICP-MS	EPA 6020B	Cobalt
ICP-MS	EPA 6020B	Copper
ICP-MS	EPA 6020B	Iron
ICP-MS	EPA 6020B	Lead
ICP-MS	EPA 6020B	Magnesium
ICP-MS	EPA 6020B	Manganese
ICP-MS	EPA 6020B	Molybdenum
ICP-MS	EPA 6020B	Nickel
ICP-MS	EPA 6020B	Potassium
ICP-MS	EPA 6020B	Selenium
ICP-MS	EPA 6020B	Silver
ICP-MS	EPA 6020B	Sodium
ICP-MS	EPA 6020B	Thallium
ICP-MS	EPA 6020B	Vanadium
ICP-MS	EPA 6020B	Zinc
CVAf	EPA 245.7	Mercury
GC-ECD	EPA 8082B	Arochlor 1016
GC-ECD	EPA 8082B	Arochlor 1221
GC-ECD	EPA 8082B	Arochlor 1232
GC-ECD	EPA 8082B	Arochlor 1242
GC-ECD	EPA 8082B	Arochlor 1248
GC-ECD	EPA 8082B	Arochlor 1254
GC-ECD	EPA 8082B	Arochlor 1260
GC-Mass Spectrometer	EPA 680 modified (SIM)	PCB Congeners
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,4'-dichlorobiphenyl (PCB 8)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',5'-trichlorobiphenyl (PCB 18)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,4,4'-trichlorobiphenyl (PCB 28)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,5'-tetrachlorobiphenyl (PCB 44)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,5'-tetrachlorobiphenyl (PCB 49)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',5,5'-tetrachlorobiphenyl (PCB 52)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3',4,4'-tetrachlorobiphenyl (PCB 66)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,5'-pentachlorobiphenyl (PCB 87)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,5,5'-pentachlorobiphenyl (PCB 101)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3,3',4,4'-pentachlorobiphenyl (PCB 105)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,3',4,4',5'-pentachlorobiphenyl (PCB 118)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4'-hexachlorobiphenyl (PCB 128)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4'-hexachlorobiphenyl (PCB 128)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',4,4',5,5'-hexachlorobiphenyl (PCB 153)

Biological Tissue		
Technology	Method	Analyte
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5-heptachlorobiphenyl (PCB 170)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',5,5'-heptachlorobiphenyl (PCB 180)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',5,6-heptachlorobiphenyl (PCB 183)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4,4',6,6'-heptachlorobiphenyl (PCB 184)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,4',5,5',6-heptachlorobiphenyl (PCB 187)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5,6-octachlorobiphenyl (PCB 195)
GC-Mass Spectrometer	EPA 680 modified (SIM)	2,2',3,3',4,4',5,5',6-nonachlorobiphenyl (PCB 206)
GC-Mass Spectrometer	EPA 680 modified (SIM)	Decachlorobiphenyl (PCB 209)
Preparation	Method	Type
Acid Digestion	EPA 3050B	

Toxicology- Whole Effluent Testing		
Technology	Method	Analyte
Bioassay	EPA-821-R-02-013, Method 1000	Fathead Minnow Larval Survival & Growth, Chronic Assay
Bioassay	EPA-821-R-02-013, Method 1002	Ceriodaphnia dubia Survival & Reproduction, Chronic Assay
Bioassay	EPA-821-R-02-014, Method 1007	Mysidopsis bahia Survival, Growth, & Fecundity, Chronic Assay
Bioassay	EPA-821-R-02-014, Method 1005	Sheepshead Minnow Larval Survival & Growth, Chronic Assay
Bioassay	EPA-821-R-02-014, Method 1008	Arbacia punctulata Sperm Immobilization, Chronic Assay
Bioassay	EPA-821-R-02-014, Method 1006	Menidia beryllina Larval Survival & Growth, Chronic Assay
Bioassay	EPA-821-R-02-012, Method 2000	Fathead Minnow, Acute Assay
Bioassay	EPA-821-R-02-012, Method 2002	Ceriodaphnia dubia, Acute Assay
Bioassay	EPA-821-R-02-012, Method 2021	Daphnia pulex, Acute Assay
Bioassay	EPA-821-R-02-012, Method 2007	Americamysis bahia, Acute Assay
Bioassay	EPA-821-R-02-012, Method 2006	Menidia beryllina, Acute Assay
Bioassay	EPA-821-R-02-012, Method 2004	Cyprinodon variegatus, Acute Assay

Toxicology – Sediment and Soil		
Technology	Method	Analyte
Bioassay	ASTM E 1706 EPA 600-R-99-064, Method 100.1	<i>Hyalella azteca</i> 10-day Acute Exposure Assay
Bioassay	ASTM E 1706 EPA 600-R-99-064, Method 100.2	<i>Chironomus dilutus</i> 10-day Acute Exposure Assay
Bioassay	EPA 600-R-99-064, Method 100.3	<i>Lumbriculus variegatus</i> 28-day Bioaccumulation Assay
Bioassay	EPA 600-R-99-064, Method 100.4	<i>Hyalella azteca</i> 28/42-day Chronic Exposure Assay
Bioassay	ASTM E 1706 EPA 600-R-99-064, Method 100.5	<i>Chironomus dilutus</i> Life Cycle Chronic Exposure Assay with 20 day endpoint
Bioassay	ASTM E 1367 EPA 600/R-01/020	<i>Leptocheirus plumulosus</i> 10-day Chronic Exposure Assay
Bioassay	EPA 600/R-01/020	<i>Leptocheirus plumulosus</i> 28-day Chronic Exposure Assay
Bioassay	ASTM E 1563	Echinoderm Embryo Acute Exposure Assay (eg. <i>Arbacia punctulata</i>)
Bioassay	ASTM E1611	Marine Polychaete Sediment Toxicity Test (<i>Neanthes arenaceodentata</i>)
Bioassay	ASTM E 1688	Benthic Invertebrate Bioaccumulation Evaluation (eg. <i>Nereis virens</i> , <i>Macoma nasuta</i> , <i>Eisneia fetida</i> , <i>Lumbriculus variegatus</i>)
Bioassay	EPA 823-B-98-004	Acute Exposure, 10-day, Marine Sediment Evaluation (eg. <i>Leptocheirus plumulosus</i> , <i>Ampelisca abdita</i>)
Bioassay	EPA 823-B-98-004	Acute Exposure Water Column, Suspended Particulate Phase, Invertebrate Assays
Bioassay	EPA 823-B-98-004	Benthic Invertebrate Bioaccumulation Evaluation (eg. <i>Nereis virens</i> , <i>Macoma nasuta</i>)
Bioassay	ASTM E1963	Terrestrial Plant Acute and Chronic Exposure Toxicity Testing (eg. <i>Brassica rapa</i> , <i>Lolium perenne</i> , <i>Lactuca sativa</i> , <i>Trifolium pratense</i> and <i>Lemna minor</i> .)
Bioassay	ASTM E1676	Soil toxicity or bioaccumulation test with earthworms (eg. <i>Eisenia fetida</i>)

Notes:

- 1) This laboratory offers commercial testing service.

Approved by:


 R. Douglas Leonard
 Chief Technical Officer

 Date: June 12, 2013

Issued: 11/28/12 Revised: 11/29/12 Revised: 6/12/13

Declaration of Conformance to the Department of Defense Quality Systems Manual for Environmental Laboratories Version 4.1 (DoD QSM)

Environmental laboratories performing services for the Department of Defense must possess any required state or host nation certification and/or be accredited for each applicable test method by a nationally recognized laboratory accreditation body (e.g. NELAP) compliant with ISO/IEC 17011:2004. The laboratory must demonstrate the ability to generate acceptable results from the analysis of proficiency-testing (PT) sample(s), subject to availability, using each applicable method in the specified matrix. Upon request, laboratories must make available, to the Department of Defense, the results of all PT samples analyzed by the laboratory during the contract-specified period of performance. Laboratories must have an established and documented laboratory quality system that conforms to ISO/IEC 17025 as implemented by the *DoD Quality Systems Manual for Environmental Laboratories, Version 4.1*. This document may be downloaded free of charge at <http://www.navylabs.navy.mil/QSM%20Version%204.1.pdf>. The laboratory must declare conformance to the DoD QSM using this form and must submit a copy of its laboratory quality manual (however named) to an authorized representative of the Department of Defense. All laboratories are subject to on-site assessments by authorized representatives of the Department of Defense. The laboratory must notify the Department of Defense, in writing, of any change in laboratory certification or accreditation status within 30 calendar days of the change.

Laboratory Information

Laboratory Name: EnviroSystems, Inc.(ESI)
Address: 1 Lafayette Road, PO Box 778
Hampton, NH 03842 (Shipping Zip Code) 03843-0778 (Mailing Zip Code)

Point of Contact: Petra Karbe
Title: CEO/CFO
Email: pkarbe@envirosystems.com
Phone: 603-926-3345 ext. 214
Fax: 603-926-3521

Title, date of laboratory quality manual

EnviroSystems, Inc. Quality Assurance Manual, Covering Environmental Toxicology, Microbiology, and Analytical Chemical Testing Services. Dated: April 2012

List analytes/analyte groups, matrices, methods for which this declaration applies:
Please see the attached ESI Department of Defense Accreditation list.

Identify laboratory standard operating procedures (SOPs) for which this declaration applies (include number, title and date of last revision):

Please see the attached ESI Department of Defense Accreditation List plus attached SOPs.

1. Quality System

- a. Does the laboratory quality manual meet the requirements of DoD QSM Sections 4.2.2, 4.2.3, and 4.2.4? **Yes.**
- b. Do laboratory SOPs meet the requirements of DoD QSM Section 5.4.1? **Yes.**
- c. Are laboratory records controlled in accordance with the requirements of DoD QSM Section 4.12? **Yes.**
- d. Do your laboratory personnel structure and lines of responsibility meet the requirements of DoD QSM Section 4.1.5? **Yes.**
- e. Does your laboratory Quality Manager meet requirements of DoD QSM Section 4.1.5(i)? **Yes.**
- f. Does your laboratory perform internal audits, management reviews, and corrective action in accordance with DoD QSM Sections 4.13, 4.14, and 4.10? **Yes.**

2. Training and Ethics

- a. Does your laboratory's technical training program meet the requirements of DoD QSM Section 5.2.6? **Yes.**
- b. Does your laboratory ethics program comply with the requirements of DoD QSM Section 5.2.7? **Yes.**

3. Proficiency Testing

- a. List all proficiency testing programs (e.g. UST, DMRQA) in which your laboratory participates that are relevant to the analytes/analyte groups, matrices, and methods included in the scope of this declaration: **WP, DMR QA.**

4. Resources

- a. Does your laboratory have adequate personnel, facilities, equipment, instrumentation, and other resources available, as required in DoD QSM Sections 5.2.1, 5.3.1, and 5.5, to perform the tests specified in this declaration? **Yes.**

5. Please list any concerns/comments regarding conformance to the DoD QSM:

The undersigned acknowledge the accuracy and correctness of this declaration. The undersigned acknowledge that laboratory engagement in any prohibited practice identified in Attachment 1a will be considered material non-compliance, which may result in contract termination or other remedies as appropriate.

Laboratory Quality Manager: __Kenneth A. Simon__

Signature: _____

Date: __10/28/2013__

Laboratory's Authorized Contract Representative: Petra Karbe

Signature:

Date: 10/28/2013

Attachment 1a

Prohibited Practices (Involving Environmental Sampling and Testing Activities)

The following prohibited practices will be considered material non-compliance, which may result in contract termination or other remedies as appropriate.

- Fabrication, falsification, or misrepresentation of data
 - Creating data for an analysis that was not performed
 - Creating information for a sample that was not collected
 - Using external analysts, equipment and/or laboratories to perform analyses when not allowed by contract
- Improper clock setting (time traveling) or improper date/time recording
 - Resetting the internal clock on an instrument to make it appear that a sample was analyzed within holding time when in fact it was not
 - Changing the actual time or recording a false time to make it appear that holding times were met, or changing the times for sample collection, extractions or other steps to make it appear that holding times were met
- Unwarranted manipulation of samples, software, or analytical conditions
 - Unjustified dilution of samples
 - Manipulating GC/MS tuning data to produce an ion abundance result that appears to meet specific QC criteria
 - Changing the instrument conditions for sample analysis from the conditions used for standard analysis (e.g., changing EM voltage)
 - Unwarranted manipulation of computer software, e.g. forcing calibration or QC data to meet criteria, removing computer operational codes such as the “M” flag, inappropriately subtracting background, or improperly manipulating the chromatographic baseline
 - Turning off, or otherwise disabling, electronic instrument audit/tracking functions
- Misrepresenting or misreporting QC samples
 - Representing spiked samples as being digested or extracted when this has not been done
 - Substituting previously generated runs for a non-compliant calibration or QC run to make it appear that an acceptable run was performed
 - Failing to prepare or analyze method blanks and LCS in the same manner that samples were prepared or analyzed
 - Tampering with QC samples and results, including over spiking and adding surrogates after sample extraction
 - Performing multiple calibrations or QC runs (including CCVs, LCSs, spikes, duplicates and blanks) until one meets criteria, rather than taking needed corrective action, and not documenting or retaining data for the other unacceptable data
 - Deleting or failing to record non-compliant QC data to conceal the fact that calibration or other QC analyses were non-compliant
- Improper calibrations
 - Discarding points in the initial calibration to force the calibration to be acceptable
 - Discarding points from an MDL study to force the calculated MDL to be higher or lower than the actual value
 - Using an initial calibration that does not correspond to the actual run sequence to make continuing calibration data look acceptable when in fact it was not
 - Performing improper manual integrations, including peak shaving, peak enhancing, or baseline manipulation to achieve QC criteria or to avoid corrective action

- Concealing a known analytical or sample problem
- Concealing a known improper or unethical behavior or action
- Failing to report the occurrence of a prohibited practice or known improper or unethical act to the appropriate laboratory or contract representative, or to an appropriate government official.



State of New Hampshire
Environmental Laboratory Accreditation Program
Awards
PRIMARY ACCREDITATION

to
ENVIROSYSTEMS INC
of
HAMPTON, NH

For the analytes listed on the attached page(s) in accordance
with the provisions on the NELAC Standards and Env-C 300.

Certificate Number: 151313

Effective Date: 06/15/2013

Expiration Date: 06/14/2014

Laboratory ID: 1513



NELAP RECOGNIZED

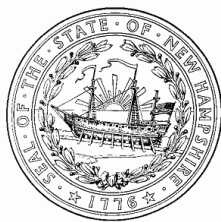
Bill Hall
ENVIROSY: 06/13/2013

Bill Hall
NH ELAP Program Manager

Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation. Continuing accreditation status is dependent on successful ongoing participation in the program. Customers may verify the lab's current accreditation status by calling (603) 271-2998

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

29 Hazen Drive, PO Box 95, Concord, NH 03302 (603) 271-2998



PRIMARY ACCREDITATION PARAMETER LIST

ANALYTE LIST NUMBER: 151313-A

ENVIROSYSTEMS INC
1 LAFAYETTE RD

HAMPTON NH 03842
(603) 926-3345
Lab ID: 1513



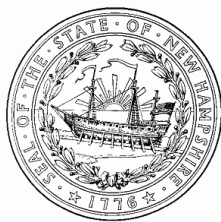
NELAP RECOGNIZED

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
Method Code: 10014605 Method Ref.: EPA 200.8		Revision: 5.4		Date: 1994		
1000	ALUMINUM, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1005	ANTIMONY, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1010	ARSENIC, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1015	BARIUM, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1020	BERYLLIUM, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1030	CADMIUM, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1040	CHROMIUM, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1055	COPPER, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1075	LEAD, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1090	MANGANESE, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1105	NICKEL, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1140	SELENIUM, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1150	SILVER, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1165	THALLIUM, TOTAL	12/09/2011	06/14/2014	D	MET	NE
1190	ZINC, TOTAL	12/09/2011	06/14/2014	D	MET	NE
Method Code: 10088809 Method Ref.: EPA 524.2		Revision: 4.1		Date: 1995		
4375	BENZENE	10/22/2012	06/14/2014	D	VOC	NE
4455	CARBON TETRACHLORIDE	10/22/2012	06/14/2014	D	VOC	NE
4475	CHLOROBENZENE	10/22/2012	06/14/2014	D	VOC	NE
4610	1,2-DICHLOROBENZENE	10/22/2012	06/14/2014	D	VOC	NE
4620	1,4-DICHLOROBENZENE	10/22/2012	06/14/2014	D	VOC	NE
4635	1,2-DICHLOROETHANE	10/22/2012	06/14/2014	D	VOC	NE
4640	1,1-DICHLOROETHENE	10/22/2012	06/14/2014	D	VOC	NE
4655	1,2-DICHLOROPROPANE	10/22/2012	06/14/2014	D	VOC	NE
4700	TRANS-1,2-DICHLOROETHYLENE	10/22/2012	06/14/2014	D	VOC	NE
4765	ETHYLBENZENE	10/22/2012	06/14/2014	D	VOC	NE
4975	DICHLOROMETHANE (METHYLENE CHLORIDE)	10/22/2012	06/14/2014	D	VOC	NE
5115	TETRACHLOROETHENE (PERCHLOROETHYLENE)	10/22/2012	06/14/2014	D	VOC	NE
5140	TOLUENE	10/22/2012	06/14/2014	D	VOC	NE
5160	1,1,1-TRICHLOROETHANE	10/22/2012	06/14/2014	D	VOC	NE

This analyte list supersedes all previously issued analyte lists. Method accreditation does not imply acceptance for NHDES compliance testing. Customers may verify the laboratory's current accreditation status by calling at (603) 271-2998. Laboratory is required to use EPA approved/accepted methods where required by regulation.

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

29 Hazen Drive, PO Box 95, Concord, NH 03302 (603) 271-2998



PRIMARY ACCREDITATION PARAMETER LIST

ANALYTE LIST NUMBER: 151313-A

ENVIROSYSTEMS INC
1 LAFAYETTE RD

HAMPTON NH 03842
(603) 926-3345
Lab ID: 1513



NELAP RECOGNIZED

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
5165	1,1,2-TRICHLOROETHANE	10/22/2012	06/14/2014	D	VOC	NE
5170	TRICHLOROETHENE (TRICHLOROETHYLENE)	10/22/2012	06/14/2014	D	VOC	NE
5235	VINYL CHLORIDE	10/22/2012	06/14/2014	D	VOC	NE
Method Code: 20209603 Method Ref.: SM 9222 D (M-FC)		Revision: 20th ED		Date: 1998		
2530	FECAL COLIFORMS	09/26/2008	06/14/2014	N	MIC	NE
Method Code: 10014605 Method Ref.: EPA 200.8		Revision: 5.4		Date: 1994		
1000	ALUMINUM, TOTAL	03/23/2010	06/14/2014	N	MET	NE
1005	ANTIMONY, TOTAL	03/23/2010	06/14/2014	N	MET	NE
1010	ARSENIC, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1015	BARIUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1020	BERYLLIUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1025	BORON, TOTAL	03/23/2010	06/14/2014	N	MET	NE
1030	CADMIUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1035	CALCIUM, TOTAL	03/23/2010	06/14/2014	N	MET	NE
1040	CHROMIUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1050	COBALT, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1055	COPPER, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1070	IRON, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1075	LEAD, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1085	MAGNESIUM, TOTAL	03/23/2010	06/14/2014	N	MET	NE
1090	MANGANESE, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1100	MOLYBDENUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1105	NICKEL, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1125	POTASSIUM, TOTAL	07/31/2008	06/14/2014	N	MET	NE
1140	SELENIUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1150	SILVER, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1155	SODIUM, TOTAL	03/23/2010	06/14/2014	N	MET	NE
1165	THALLIUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1185	VANADIUM, TOTAL	09/26/2008	06/14/2014	N	MET	NE
1190	ZINC, TOTAL	09/26/2008	06/14/2014	N	MET	NE
Method Code: 10038003 Method Ref.: EPA 245.7		Revision:		Date: 1999		
1095	MERCURY, TOTAL	09/26/2008	06/14/2014	N	MET	NE

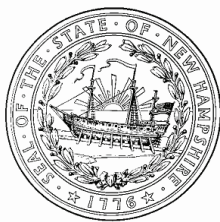
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NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

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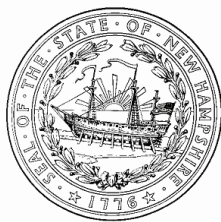
NELAP RECOGNIZED

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
Method Code: 20067009 Method Ref.: SM 3500-CR D		Revision: 19th ED	Date: 1995			
1045	CHROMIUM VI	09/26/2008	06/14/2014	N	MET	NE
Method Code: 10055206 Method Ref.: EPA 310.2		Revision:	Date: 1974			
1505	ALKALINITY	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 10127807 Method Ref.: EPA 1664A (HEM)		Revision:	Date: 1999			
1860	OIL & GREASE	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 10261606 Method Ref.: EPA 1664A (SGT-HEM)		Revision:	Date: 1999			
1860	OIL & GREASE	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20023409 Method Ref.: SM 4500-NH3 H		Revision: 18th ED	Date: 1992			
1515	AMMONIA	09/26/2008	06/14/2014	N	NMI	NE
1795	KJELDAHL NITROGEN, TOTAL (TKN)	11/04/2009	06/14/2014	N	NMI	NE
Method Code: 20048208 Method Ref.: SM 2510 B		Revision: 20th ED	Date: 1998			
1610	CONDUCTIVITY	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20049007 Method Ref.: SM 2540 B		Revision: 20th ED	Date: 1998			
1950	RESIDUE, TOTAL	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20050004 Method Ref.: SM 2540 C		Revision: 20th ED	Date: 1998			
1955	RESIDUE, FILTERABLE (TDS)	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20050800 Method Ref.: SM 2540 D		Revision: 20th ED	Date: 1998			
1960	RESIDUE, NON-FILTERABLE (TSS)	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20084804 Method Ref.: SM 4500-CL C		Revision: 20th ED	Date: 1998			
1575	CHLORIDE	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20092404 Method Ref.: SM 4500-CN E		Revision: 20th ED	Date: 1998			
1645	CYANIDE, TOTAL	05/30/2012	06/14/2014	N	NMI	NE
Method Code: 20104807 Method Ref.: SM 4500-H+ B		Revision: 20th ED	Date: 1998			
1900	HYDROGEN ION (PH)	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20111006 Method Ref.: SM 4500-NH3 G		Revision: 20th ED	Date: 1998			
1515	AMMONIA	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20116205 Method Ref.: SM 4500-NO3 F		Revision: 20th ED	Date: 1998			
1825	NITRATE-NITRITE, TOTAL	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20123802 Method Ref.: SM 4500-P E		Revision: 20th ED	Date: 1998			
1870	ORTHOPHOSPHATE AS P	09/26/2008	06/14/2014	N	NMI	NE
1910	PHOSPHORUS, TOTAL	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20131800 Method Ref.: SM 4500-SO4 D		Revision: 20th ED	Date: 1998			
2000	SULFATE	05/29/2012	06/14/2014	N	NMI	NE

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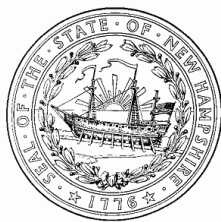
NELAP RECOGNIZED

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
Method Code: 20134809 Method Ref.: SM 5210 B		Revision: 20th ED		Date: 1998		
1530	BIOLOGICAL OXYGEN DEMAND (BOD)	09/26/2008	06/14/2014	N	NMI	NE
1555	CARBONACEOUS BIOLOGICAL OXYGEN DEMAND	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20135608 Method Ref.: SM 5220 C		Revision: 20th ED		Date: 1998		
1565	COD	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20138403 Method Ref.: SM 5310 C		Revision: 20th ED		Date: 1998		
2040	TOTAL ORGANIC CARBON (TOC)	09/26/2008	06/14/2014	N	NMI	NE
Method Code: 20118803 Method Ref.: SM 4500-NORG B		Revision: 20th ED		Date: 1998		
1462	TKN DIGESTION & DISTILLATION	09/26/2008	06/14/2014	N	PRE	NE
Method Code: 10299806 Method Ref.: EPA 624		Revision: Appendix A		Date: 1982		
4315	ACETONE	09/26/2008	06/14/2014	N	VOC	NE
4325	ACROLEIN (PROPENAL)	09/26/2008	06/14/2014	N	VOC	NE
4340	ACRYLONITRILE	09/26/2008	06/14/2014	N	VOC	NE
4375	BENZENE	09/26/2008	06/14/2014	N	VOC	NE
4395	BROMODICHLOROMETHANE	09/26/2008	06/14/2014	N	VOC	NE
4400	BROMOFORM	09/26/2008	06/14/2014	N	VOC	NE
4455	CARBON TETRACHLORIDE	09/26/2008	06/14/2014	N	VOC	NE
4475	CHLOROBENZENE	09/26/2008	06/14/2014	N	VOC	NE
4485	CHLOROETHANE	09/26/2008	06/14/2014	N	VOC	NE
4500	2-CHLOROETHYL VINYL ETHER	09/26/2008	06/14/2014	N	VOC	NE
4505	CHLOROFORM	09/26/2008	06/14/2014	N	VOC	NE
4575	DIBROMOCHLOROMETHANE	09/26/2008	06/14/2014	N	VOC	NE
4610	1,2-DICHLOROBENZENE	09/26/2008	06/14/2014	N	VOC	NE
4615	1,3-DICHLOROBENZENE	09/26/2008	06/14/2014	N	VOC	NE
4620	1,4-DICHLOROBENZENE	09/26/2008	06/14/2014	N	VOC	NE
4630	1,1-DICHLOROETHANE	09/26/2008	06/14/2014	N	VOC	NE
4635	1,2-DICHLOROETHANE	09/26/2008	06/14/2014	N	VOC	NE
4640	1,1-DICHLOROETHENE	09/26/2008	06/14/2014	N	VOC	NE
4655	1,2-DICHLOROPROPANE	09/26/2008	06/14/2014	N	VOC	NE
4680	CIS-1,3-DICHLOROPROPENE	09/26/2008	06/14/2014	N	VOC	NE
4685	TRANS-1,3-DICHLOROPROPENE	09/26/2008	06/14/2014	N	VOC	NE
4700	TRANS-1,2-DICHLOROETHYLENE	09/26/2008	06/14/2014	N	VOC	NE

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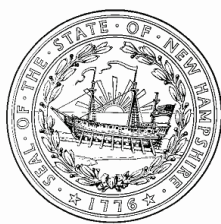
NELAP RECOGNIZED

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
4765	ETHYLBENZENE	10/20/2011	06/14/2014	N	VOC	NE
4950	BROMOMETHANE (METHYL BROMIDE)	09/26/2008	06/14/2014	N	VOC	NE
4960	CHLOROMETHANE (METHYL CHLORIDE)	09/26/2008	06/14/2014	N	VOC	NE
4975	DICHLOROMETHANE (METHYLENE CHLORIDE)	09/26/2008	06/14/2014	N	VOC	NE
5110	1,1,2,2-TETRACHLOROETHANE	09/26/2008	06/14/2014	N	VOC	NE
5115	TETRACHLOROETHENE (PERCHLOROETHYLENE)	09/26/2008	06/14/2014	N	VOC	NE
5140	TOLUENE	09/26/2008	06/14/2014	N	VOC	NE
5160	1,1,1-TRICHLOROETHANE	09/26/2008	06/14/2014	N	VOC	NE
5165	1,1,2-TRICHLOROETHANE	09/26/2008	06/14/2014	N	VOC	NE
5170	TRICHLOROETHENE (TRICHLOROETHYLENE)	09/26/2008	06/14/2014	N	VOC	NE
5175	TRICHLOROFLUOROMETHANE	09/26/2008	06/14/2014	N	VOC	NE
5235	VINYL CHLORIDE	09/26/2008	06/14/2014	N	VOC	NE
Method Code: 10300002 Method Ref.: EPA 625		Revision: Appendix A		Date: 1982		
4835	HEXACHLOROBUTADIENE	09/26/2008	06/14/2014	N	VOC	NE
4840	HEXACHLOROETHANE	09/26/2008	06/14/2014	N	VOC	NE
5005	NAPHTHALENE	09/26/2008	06/14/2014	N	VOC	NE
5015	NITROBENZENE	09/26/2008	06/14/2014	N	VOC	NE
5155	1,2,4-TRICHLOROBENZENE	09/26/2008	06/14/2014	N	VOC	NE
Method Code: 10300002 Method Ref.: EPA 625		Revision: Appendix A		Date: 1982		
5500	ACENAPHTHENE	09/26/2008	06/14/2014	N	SBN	NE
5505	ACENAPHTHYLENE	09/26/2008	06/14/2014	N	SBN	NE
5555	ANTHRACENE	09/26/2008	06/14/2014	N	SBN	NE
5575	BENZO(A)ANTHRACENE	09/26/2008	06/14/2014	N	SBN	NE
5580	BENZO(A)PYRENE	09/26/2008	06/14/2014	N	SBN	NE
5585	BENZO(B)FLUORANTHENE	09/26/2008	06/14/2014	N	SBN	NE
5590	BENZO(G,H,I)PERYLENE	09/26/2008	06/14/2014	N	SBN	NE
5595	BENZIDINE	09/26/2008	06/14/2014	N	SBN	NE
5600	BENZO(K)FLUORANTHENE	09/26/2008	06/14/2014	N	SBN	NE
5660	4-BROMOPHENYL PHENYL ETHER	09/26/2008	06/14/2014	N	SBN	NE
5670	BENZYL BUTYL PHTHALATE	09/26/2008	06/14/2014	N	SBN	NE
5760	BIS(2-CHLOROETHOXY) METHANE	09/26/2008	06/14/2014	N	SBN	NE

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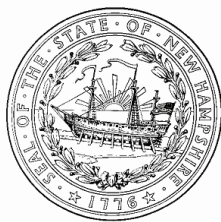
NELAP RECOGNIZED

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5765	BIS(2-CHLOROETHYL) ETHER	09/26/2008	06/14/2014	N	SBN	NE
5780	BIS(2-CHLOROISOPROPYL) ETHER	09/26/2008	06/14/2014	N	SBN	NE
5795	2-CHLORONAPHTHALENE	09/26/2008	06/14/2014	N	SBN	NE
5800	2-CHLOROPHENOL	09/26/2008	06/14/2014	N	SBN	NE
5825	4-CHLOROPHENYL PHENYL ETHER	09/26/2008	06/14/2014	N	SBN	NE
5855	CHRYSENE	09/26/2008	06/14/2014	N	SBN	NE
5895	DIBENZO(A,H)ANTHRACENE	09/26/2008	06/14/2014	N	SBN	NE
5925	DI-N-BUTYL PHTHALATE	09/26/2008	06/14/2014	N	SBN	NE
5945	3,3 -DICHLOROBENZIDINE	09/26/2008	06/14/2014	N	SBN	NE
6000	2,4-DICHLOROPHENOL	09/26/2008	06/14/2014	N	SBN	NE
6065	BIS(2-ETHYLHEXYL) PHTHALATE	09/26/2008	06/14/2014	N	SBN	NE
6070	DIETHYL PHTHALATE	09/26/2008	06/14/2014	N	SBN	NE
6135	DIMETHYL PHTHALATE	10/20/2011	06/14/2014	N	SBN	NE
6185	2,4-DINITROTOLUENE (2 4-DNT)	09/26/2008	06/14/2014	N	SBN	NE
6190	2,6-DINITROTOLUENE (2 6-DNT)	09/26/2008	06/14/2014	N	SBN	NE
6200	DI-N-OCTYL PHTHALATE	09/26/2008	06/14/2014	N	SBN	NE
6265	FLUORANTHENE	09/26/2008	06/14/2014	N	SBN	NE
6270	FLUORENE	09/26/2008	06/14/2014	N	SBN	NE
6315	INDENO(1,2,3-CD)PYRENE	09/26/2008	06/14/2014	N	SBN	NE
6320	ISOPHORONE	09/26/2008	06/14/2014	N	SBN	NE
6360	2-METHYL-4,6-DINITROPHENOL	09/26/2008	06/14/2014	N	SBN	NE
6490	2-NITROPHENOL	09/26/2008	06/14/2014	N	SBN	NE
6500	4-NITROPHENOL	09/26/2008	06/14/2014	N	SBN	NE
6530	N-NITROSODIMETHYLAMINE	09/26/2008	06/14/2014	N	SBN	NE
6535	N-NITROSODIPHENYLAMINE	09/26/2008	06/14/2014	N	SBN	NE
6545	N-NITROSODI-N-PROPYLAMINE	09/26/2008	06/14/2014	N	SBN	NE
6605	PENTACHLOROPHENOL	09/26/2008	06/14/2014	N	SBN	NE
6615	PHENANTHRENE	09/26/2008	06/14/2014	N	SBN	NE
6625	PHENOL	09/26/2008	06/14/2014	N	SBN	NE
6665	PYRENE	09/26/2008	06/14/2014	N	SBN	NE
6840	2,4,6-TRICHLOROPHENOL	09/26/2008	06/14/2014	N	SBN	NE

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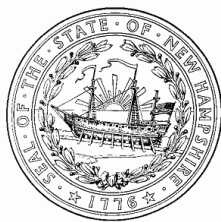
NELAP RECOGNIZED

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
Method Code: 10296205 Method Ref.: EPA 608		Revision: Appendix A	Appendix A	Date: 1982		
8880	AROCOR-1016 (PCB-1016)	09/26/2008	06/14/2014	N	SPC	NE
8885	AROCOR-1221 (PCB-1221)	09/26/2008	06/14/2014	N	SPC	NE
8890	AROCOR-1232 (PCB-1232)	09/26/2008	06/14/2014	N	SPC	NE
8895	AROCOR-1242 (PCB-1242)	09/26/2008	06/14/2014	N	SPC	NE
8900	AROCOR-1248 (PCB-1248)	09/26/2008	06/14/2014	N	SPC	NE
8905	AROCOR-1254 (PCB-1254)	09/26/2008	06/14/2014	N	SPC	NE
8910	AROCOR-1260 (PCB-1260)	09/26/2008	06/14/2014	N	SPC	NE
Method Code: 10296205 Method Ref.: EPA 608		Revision: Appendix A	Appendix A	Date: 1982		
7025	ALDRIN	09/26/2008	06/14/2014	N	SPE	NE
7105	DELTA-BHC	09/26/2008	06/14/2014	N	SPE	NE
7110	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEXANE)	09/26/2008	06/14/2014	N	SPE	NE
7115	BETA-BHC (BETA-HEXACHLOROCYCLOHEXANE)	09/26/2008	06/14/2014	N	SPE	NE
7120	GAMMA-BHC (LINDANE)	09/26/2008	06/14/2014	N	SPE	NE
7250	CHLORDANE (TECH.)	09/26/2008	06/14/2014	N	SPE	NE
7355	4,4-DDD	09/26/2008	06/14/2014	N	SPE	NE
7360	4,4-DDE	09/26/2008	06/14/2014	N	SPE	NE
7365	4,4-DDT	09/26/2008	06/14/2014	N	SPE	NE
7470	DIELDRIN	09/26/2008	06/14/2014	N	SPE	NE
7510	ENDOSULFAN I	09/26/2008	06/14/2014	N	SPE	NE
7515	ENDOSULFAN II	09/26/2008	06/14/2014	N	SPE	NE
7520	ENDOSULFAN SULFATE	09/26/2008	06/14/2014	N	SPE	NE
7530	ENDRIN ALDEHYDE	09/26/2008	06/14/2014	N	SPE	NE
7540	ENDRIN	09/26/2008	06/14/2014	N	SPE	NE
7685	HEPTACHLOR	09/26/2008	06/14/2014	N	SPE	NE
7690	HEPTACHLOR EPOXIDE	09/26/2008	06/14/2014	N	SPE	NE
7810	METHOXYCHLOR	09/26/2008	06/14/2014	N	SPE	NE
8250	TOXAPHENE (CHLORINATED CAMPHENE)	09/26/2008	06/14/2014	N	SPE	NE
Method Code: 10300002 Method Ref.: EPA 625		Revision: Appendix A	Appendix A	Date: 1982		
6275	HEXACHLOROBENZENE	09/26/2008	06/14/2014	N	SPE	NE
6285	HEXACHLOROCYCLOPENTADIENE	09/26/2008	06/14/2014	N	SPE	NE

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Method Code: 10215608	Method Ref.: EPA 2021.0 EPA/821/R-02/012	Revision: 5TH ED	Date: OCT-02			
3355	DAPHNIA PULEX	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10216407	Method Ref.: EPA 2006.0 EPA/821/R-02/012	Revision: 5TH ED	Date: OCT-02			
3380	MENIDIA BERYLLINA (INLAND SILVERSIDE)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10252605	Method Ref.: EPA 1000.0 EPA/821/R-02/013	Revision: 4th ED	Date: OCT-02			
3410	PIMEPHALES PROMELAS (FATHEAD MINNOW)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10252809	Method Ref.: EPA 1001.0 EPA/821/R-02/013	Revision: 4th ED	Date: OCT-02			
3410	PIMEPHALES PROMELAS (FATHEAD MINNOW)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10253006	Method Ref.: EPA 1002.0 EPA/821/R-02/013	Revision: 4th ED	Date: OCT-02			
3315	CERIODAPHNIA DUBIA (DAPHNID)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10253200	Method Ref.: EPA 1003.0 EPA/821/R-02/013	Revision: 4th ED	Date: OCT-02			
3420	SELENASTRUM CAPRICORNUTUM (GREEN ALGA)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10253802	Method Ref.: EPA 1006.0 EPA/821/R-03/014	Revision: 3rd ED	Date: OCT-02			
3380	MENIDIA BERYLLINA (INLAND SILVERSIDE)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10254009	Method Ref.: EPA 1007.0 EPA/821/R-03/014	Revision: 3rd ED	Date: OCT-02			
3395	MYSIDOPSIS BAHIA (MYSID)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10254203	Method Ref.: EPA 1008.0 EPA/821/R-03/014	Revision: 3rd ED	Date: OCT-02			
3305	ARBACIA PUNCTULATA (SEA URCHIN)	09/26/2008	06/14/2014	N	WET	NE
Method Code: 10264809	Method Ref.: EPA 2000.0 EPA/821/R-02/012	Revision: 5TH ED	Date: OCT-02			
3410	PIMEPHALES PROMELAS (FATHEAD MINNOW)	09/26/2008	06/14/2014	N	WET	NE
Method Code: NH0113	Method Ref.: EPA 2019.0 EPA/821/R-02/012	Revision: 5TH ED	Date: OCT-02			
3405	ONCORHYNCHUS MYKISS (RAINBOW TROUT)	09/26/2008	06/14/2014	N	WET	NE
3415	SALVELINUS FONTINALIS (BROOK TROUT)	09/26/2008	06/14/2014	N	WET	NE
Method Code: NH0114	Method Ref.: EPA 2007.0 EPA/821/R-02/012	Revision: 5TH ED	Date: OCT-02			
3395	MYSIDOPSIS BAHIA (MYSID)	09/26/2008	06/14/2014	N	WET	NE
Method Code: NH0116	Method Ref.: EPA 2002.0 EPA/821/R-02/012	Revision: 5TH ED	Date: OCT-02			
3315	CERIODAPHNIA DUBIA (DAPHNID)	09/26/2008	06/14/2014	N	WET	NE

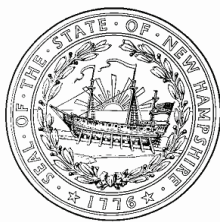
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ENVIROSYS06/13/2013

Bill Hall
NH ELAP Program Manager
Issue Date: 06/13/2013

Matrix Legend: D=Drinking Water; N=Non-Potable Water; SC=Solid and Chemical Materials

Category Legend: MIC=Microbiology; MET=Metals; NMI=Non-Metal Inorganics; PRE=Preparation; VOC=Volatile Organic Compounds; SBN=SVOC-BNA; SHE=SVOC-Herbicides; SNO=SVOC-NOS; SPC=SVOC-PCB; SPE=SVOC-Pesticides; RAD=Radiochemistry; WET=Wet

Accreditation Legend: NE=NELAP; NH=NH State Certification; CE=State Certification; IN=Interim (NELAP); WI=Withdrawn; AP=Applied; RE=Revoked; SU=Suspended

Appendix D
Response to Partnering Team Comments

Reviewer: Kyle Newman**Responding Firm:** CH2M HILL**Document:** Oceana Skeet & Trap Range Draft SAP**Date:** 22-May-14 &
18-June-14**Date:** 25-June-14

Comment Number	Worksheet and/or Section	Comment	Response
1	general	Throughout the document surface samples are given a range of 0-12." Generally only soils samples collected from the 0-2" range are considered surface samples. It should be noted for sediments the range of surface samples is listed as 0-6."	The referenced soil depth range of 0-2 inches typically applies to multi-incremental samples (MIS); this method is not proposed at this site for the collection of soil samples. A soil depth range of 0-12 inches encompasses the highest potential exposures for terrestrial ecological receptors and is also a reasonable depth for evaluating potential human exposures, especially considering the historical nature of potential releases at the site. For sediment, the actual depth with the highest ecological exposure potential will vary depending on the depth of the redox boundary, but a maximum depth of 6 inches will capture all likely ecological exposures and also is a reasonable depth for evaluating potential human exposures. These depth ranges (for both soil and sediment) are also consistent with the depth of previously-collected samples, allowing the data from the proposed samples to be seamlessly integrated with the existing data set. Thus, no changes to the SAP are proposed in response to this comment.
	Comment 1 Response	Samples need to be taken that are indicative of current exposures, which would be the 0-2" range for non-intrusive activities. While still in the biologically active zone (for eco risk purposes), a sample at a 12" depth shouldn't be considered as a "surface" sample under the current use scenario. Samples in the 0-2" range are considered appropriate for surface soil sampling regardless of the sampling approach used (discrete, MIS, etc.).	In some situations, shallow soil depths, such as the 0-2 inch range, would be appropriate. For example, an evaluation of an open detonation site where materials would be deposited on the soil surface would appropriately use a shallow surface depth (e.g., 0-2 inches, the recommended depth for MIS samples); likewise, for evaluations of combustion sources, surface soil depths as shallow as 1 cm have typically been used. However, at the STR, while the original "releases" (shotgun pellets) would have been to the soil surface, the many decades that have passed since the range was active would have allowed the pellets to become incorporated into deeper portions of the soil column via natural processes. Lead from the pellets also may have leached into deeper parts of the soil horizon over time. Thus, the Navy considers the 0-12 inch sample depth for surface soils as indicative of current exposures for both human and ecological receptors given the historical nature of releases at the site. Also, the 0-12 inch depth was used for the surface soil samples collected during the SI. Further, the proposed sample depths were discussed with the Partnering Team and there were no previous comments on sample depths from VDEQ during the scoping sessions for the current UFP-SAP. Since the Navy is unaware of any changes or recent guidance related to sampling depths or changes to the conceptual site model for the site, the Navy wishes to retain the 0-12 inch depth interval as currently proposed. Finally, this sample depth interval is cost effective and beneficial from a logistical standpoint since it accomplishes the data needs for the evaluation of both human health and ecological exposures.
2	general	Since the primary receptors of concern for site contaminants in fish tissues are likely ecological in nature, any fish tissue samples should be taken as whole body samples rather than fillets. These receptors will not be as selective about which tissues are consumed as humans so whole body samples will be more representative. These data could still be used to conservatively evaluate risks to fishermen.	Most ecological receptors consume fish (generally whole) in a size range well below legal size limits for recreational anglers. Since smaller fish (of the same species) tend to accumulate lower levels of contaminants than larger (and thus older) fish, their use may result in underestimating potential human exposures. Also, humans typically consume only the fillet portion of most species of fish. For these reasons, the SAP proposes the collection of different sets of fish tissue samples (if warranted by the results of Phase 1 sampling) for evaluating human (larger fish; fillet) and ecological (smaller fish; whole-body) exposures. Thus, no changes to the SAP are proposed in response to this comment.

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3	Worksheet 11	What constitutes “adequately characterized”? Without defining this term the PQOs remain murky, particularly for groundwater. How will the determination be made that groundwater sampling is necessary? Will it involve comparison of soil concentrations to soil to groundwater screening values or will another approach be utilized? Further discussion of this point in the QAPP will aid in future decision making. Similar questions can be raised regarding the approach to tissue sampling and direct toxicity evaluations of ecological receptors.	<p>The subject PQO in Worksheet 11 has been modified to the following, and no longer includes the term “adequately characterized”:</p> <p>“Potential impacts to groundwater will be evaluated by comparing the detected concentrations of lead and PAHs against soil screening levels (SSLs) from current EPA RSL tables for soil-to-groundwater leachability. Concentrations detected in soil in excess of SSLs and BTV (e.g., lead) will be used for identification of exceedances. As the SSLs with a dilution attenuation factor (DAF) of 1.0 (assumes no dilution or attenuation) are very conservative, other lines of evidence will be considered in identifying a need for further sampling for potential impacts to groundwater. The other lines of evidence, such as the mobility of the constituent, site specific release, and extent of exceedance (number of locations exceeding, depth of soil exceedance versus site groundwater depth, and how much higher the detected concentrations are than the SSL), will be considered in the determination of the need to collect groundwater samples. If the exceedance is minor (for example, a low concentration, only a small percentage of the samples exceed the SSLs, deeper soil samples show no detections, and detections exceed by less than an order of magnitude), then groundwater sampling will not be necessary.”</p> <p>In regard to tissue sampling and toxicity testing, the technical memorandum that will be prepared following the completion of the Phase 1 sampling (which will include both human health and ecological risk screenings) will be used by the Partnering Team to determine the scope and nature of any Phase 2 sampling (please see the response to Comment 4).</p>
4	Worksheet 11	How will the data be reported: “A technical memorandum will be prepared following the Phase 1 sampling if Phase 2 sampling is proposed... Utilizing the Phase 1 technical memorandum, the Partnering Team will evaluate the need for Phase 2 sampling.” These two statements are somewhat contradictory. I suggest clarifying the text to state that a Phase 1 memorandum will be completed and the Partnering Team will then use the data in the memorandum as the decision point for implementing Phase 2.	<p>The PQO related to the Phase 1 TM has been modified to read as follows:</p> <p>“Following the completion of Phase 1 sampling and data validation, a technical memorandum will be prepared to summarize the Phase 1 investigation findings, and the results of the human health and ecological risk screenings. The Phase 1 technical memorandum will be used by the Partnering Team to help determine the need for any Phase 2 sampling, and, if needed, to support development of the Phase 2 scope and sampling approach.</p> <p>If contaminant levels in soil and sediment do not pose an unacceptable risk to human and ecological receptors based on the risk screenings presented in the Phase 1 technical memorandum, the RI/FS Report will be prepared to summarize the investigation findings and propose no future action for those media.”</p>
5	Appendix B	Please provide a key for the “Comments” column.	A key has been added to this appendix table. A revised version of the table is attached.